ENGINEERING NEWS

THE ST. CLAIR TUNNEL from Port Huron to Sarnia is making fair progress. Instead of driving from intermediate shafts, work has been started at the portals, which are now just being dug out. The total length from portal to portal is about 4,620 ft., of which 2,400 ft. is under the river, which is here 42 ft. deep. The distance of the roof of the tunnel below the bed of the river averages about 25 ft. The material is blue tenacious clay throughout, plastic and putty-like in consistency. About 150 men are now at work. It does not appear likely that any considerable trouble will arise from water, although there may from gas, which at points is encountered under high pressure but small volume, so that it soon exhausts itself. The adopted section is a circle of 20 ft. 4 ins. outside, 19 ft. 10 ins. inside the clear, the lining being cast-iron segments 2 ins. thick, 6 in. flanges, 18 ins. wide; 14 segments and a key-piece about 10 x 18 ins. completing the circle. A cast-steel shield 15 ft. x 21 ft. 4 ins. is driven in front by a hydraulic pressure of 3,000 tons from 24 jacks, 10 in. x 26 in. Two 30 H. P. Root blowers are to supply air, two 50 H. P. Lidgerwood engines do the hoisting, two 100-light incandescent light plants supply illumination, and the plant generally is on a very liberal and adequate scale. The grades into and out of the tunnel are 2 per cent. for about 3,000 ft. at each end. The cost of the tunnel is likely to be high, say $2,250,000; the metal lining being very expensive; 800 tons of bolts alone will be required. The material is so fluid that it is practically impossible to make an open cut even 60 ft. deep for the approaches. We shall publish shortly full illustrations of this interesting work.

THE 550 ft. CHANNEL SPAN OF THE NEW OHIO RIVER BRIDGE, at Cincinnati, lately swung clear of its falseworks, can be classed as an unexcelled example of rapid and successful bridge erection. In the freshet of Aug. 26, last (as described in ENGINEERING NEWS of Sept. 1,) the entire falseworks, two fully rigged travelers and 13 panels of iron floor were totally lost. In five weeks the falseworks were replaced, new travelers raised and rigged and 1,200 lin. ft. of substantial pile protection put in. The first iron was run out on Sept. 30; in four weeks the span was completely connected, and on Oct. 30, it was swung clear. In accomplishing this feat, the Phœnix Bridge Co. swung the longest and heaviest simple truss ever built, a truss requiring false works of the most permanent character, 84 ft. high and 60 ft. wide on top, founded on piles 55 ft. long. The Superintendent of Erection was R. A. SIMMONS, with A. B. WILHELM as Foreman. The entire structure, one mile in length of double track railway and double roadways and sidewalks, was started in March 1888, and it will be completely finished early in 1889.

THE BROOKLYN BRIDGE, during the last year, earned in tolls $917,961.36, divided as follows:—Promenade, $16,909.63; carriageways, $67,231.59; railroad, $833,760.34. On the railway 30,331,283 passengers were carried in the year; this number for the year 1887 was 27,940,313; a gain of 2,390,970 passengers in one year, though a much less rate of increase than in the past years. The aggregate of foot and railway passengers was 33,116,816. The expenditures for 1888 amounted to $831,497.22. The rental of stores, etc., amounted to $73,828, and $11,052 was received from telegraph and telephone wires. No serious or fatal accident occurred during the year.

THE MUTUAL STEAM HEATING CO. has obtained from the Councils of Philadelphia a right to lay steam-heating pipes through the best portion of that city, over an area about 4 miles long by 1½ miles wide.

A NIAGARA RIVER BRIDGE is being discussed, leading to Grand Island near Buffalo. The rocky bottom and very swift current make the question of foundations a difficult one.

THE GENERAL RAILWAY SITUATION shows signs of improvement. The trunk line rates are to be advanced on Dec. 17 to the same point at which they stood at the time of the Vanderbilt system's cut a few weeks ago. The bone of contention is still the size of the differentials which shall be allowed to the weaker lines, and neither the pugnacious Erie nor the obstinate Pennsylvania show any signs of giving in, except as a temporary measure.

The chances for even temporary harmony seem to have been much reduced by the action of the Baltimore & Ohio, which has already withdrawn from the compact advancing rates on dressed beef from Chicago to New York on account of the size of the differential demanded by the Erie.

In the Southwest, the Missouri Pacific officials at last concluded that the best way to advance rates under present conditions was to raise them on their own system, and see if others would not do the same. At the meeting of the Directors, SAMUEL SLOAN said: "If business does not pay, we do not want it. Let us set the example of common sense and the other roads will be glad to follow us."

In the Northwest, the principal interest centers in the passenger rate cutting. The Interstate Commerce Commission have created some surprise by taking a trip to Chicago and beginning an investigation of the causes which have produced the demoralization in passenger rates. They are said to have discovered that some of the chief lines have placed tickets in the hands of scalpers for sale at one-half the regular rates. The Commission propose to exercise their power to enforce the section of the law providing that all rates shall be public and open, and stop secret rate cutting, if possible.

CHICAGO SEWAGE VS. JOLIET'S OBJECTIONS is just now one of the chief topics of discussion in the press of those two cities. Chicago has the best of it in suggesting that Joliet's opposition amounts to an expressed preference for Chicago sewage *undiluted*. That the larger city now sends down upon the smaller about 300,000 galls. per minute of rather dirty stuff, and that it is the Chicago proposition of 2 years ago to increase this volume about 600 per cent. that is now being fought. As the canal connecting the two cities now takes the sewage anyhow, and as the nuisance will only become greater as time passes, the present policy of Joliet seems short-sighted, from a sanitary point of view. But the real bone of contention is that Joliet, Peoria and other towns on the river want a ship-canal that will bring trade to their doors, and Chicago just now only seeks an outlet for its sewerage. Hence the kick.

THE NEW CROTON AQUEDUCT Construction Committee reported at a late meeting that certain of the objectors to the building of the Quaker Bridge dam represented that "they had been put to great disadvantage by reason of their inability to procure expert testimony of competent persons who were opposed to the plan." Which to any other than the bull-headed obstructionists themselves would prove that "the plan" was all right, as far as a dam at Quaker Bridge was concerned; it is the method of carrying out this plan that really interests engineers.

THE RAILROAD MILEAGE OF KANSAS is shown by the State Commission's annual report to be 8,800. This gives the State 5½ miles of railroad to every thousand inhabitants, a larger mileage in proportion to population than that of any other State. The reports of the companies to the Commission for the year ending June 30, show that of the total, 2,512 miles were operated at a net loss of $878,619. Besides this, 4,301 miles of lines which earned enough to meet their operating expenses, did not earn enough to meet their interest charges. The aggregate interest charges which were not met by the receipts were $5,129,568. The total gross earnings were $74,022,045, while the operating expenses, taxes, interest and dividends were $82,898,228. The total dividends paid were $8,385,995. It is thus seen that the total gross earnings of the companies were not quite sufficient to pay the cost of operating the road and the interest on the capital invested.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was the derailment, on Dec. 9, of a passenger train on the Atlantic & Pacific, at a point called Crockton, in Johnson's cañon. The engine jumped the track when near the head of the cañon approaching the tunnel, and the engine, tender, mail, baggage, express, and one emigrant car rolled down the steep side of the mountain, a distance of 150 ft. Most of the other cars were pulled off the track, but did not go down the hill. Several persons were injured but none killed.——On Dec. 7, a freight train ran off the track at the entrance to the Victoria bridge on the Montreal side and was dragged into the tube. Three of the cars were derailed, stopping traffic for four hours.

TWO SWITCH ACCIDENTS are reported: On Dec. 5 a New York & New England train was derailed near Providence, R. I.; the switch was a planed rail facing switch, and a bolt in the rod holding the switch rail dropped out, allowing the rail to move.——On Dec. 10, the engineer of a train from Hartford, Conn., on the Valley division of the New York, New Haven & Hartford, failed to notice a signal against him at the crossing of the New England road a short distance from the station, and the derailing switch operated by the signal threw the train from the track. It required about an hour and a half to get the train on the rails, but the time was better spent in this way than in clearing the tracks of the wreck which might have occurred but for the use of the derailing switch. A dense fog is said to have obscured the signal at the time.

A ROOF fell at East Newark, N. J., on Dec. 11, under circumstances which seem to indicate carelessness on the part of the men in charge of the erection. The roof was being erected by the Illingworth Steel Co. and a considerable part had been built. "Workmen were hoisting a heavy girder. When it was got into position it was found that it would not fit into the resting places intended for it. Orders were given to strain the uprights so that the ends of the girder would slip into the slots. The carrying out of this order weakened the whole roof framework, and it began to sway." The men got out of the way before the roof fell, but two of them were injured.

A STRONG SHOCK OF EARTHQUAKE, lasting nearly half a minute, was felt Dec. 7 at Rimouski, Father Point, Sainte Flavie and Trois Pistoles, in Quebec. At Rimouski the shock was so severe as to cause the Bishop's palace to tremble visibly, but no damage was done.

A ROCK SLIDE occurred recently on the Canadian Pacific Railway, in the Selkirks, east of Yale. It was caused by the heavy rains.

THE EAMES VACUUM BRAKE CO. has issued the following circular in regard to the charges of infringement noticed on the first page of our last issue:

"It having been asserted that certain forms of driver-brakes manufactured by the Eames Vacuum Brake Co. infringe the patents upon driver brake apparatus issued to Mr. GEO. H. POOR, and assigned to the American Brake Co., and a suit having been brought for such alleged infringement by the Westinghouse Air Brake Co., the Eames Co. desires to satisfy all persons interested that such claim and such suit is utterly without foundation; that it is not brought to try the question of infringement upon its merits, but to meet and check, if possible, business competition which has become serious, by alarming the customers of the Eames Co. by suggestions or threats of law suits and expense. And the Eames Co. hereby give notice that it will protect its customers in the use of its manufactures, and whenever desired will furnish a guaranty to indemnify and save harmless against all suits, claims or damages growing out of such use."

THE ROBINSON CONNECTING ROD FOR RAILWAY SWITCHES, manufactured by the Standard Switch Co., of Topeka, Kan., has been adopted by the Denver & Rio Grande as its standard on all present and future lines, and it has closed a contract with the switch company. This rod is the standard adopted on all the Santa Fé lines from Chicago to the Pacific, and on many other Western roads. It has no bolts at either end.

THE GREAT EASTERN was sold by piecemeal last month and realized the sum of £215,000. The copper brought $14,800; the gun-metal, $22,400; brass $19,900; lead, $20,925, and the inner iron plates, beams etc., $61,150. The "breaking-up" will commence in January, and is expected to cost about £2.40 to £3.60 per ton of material, in labor.

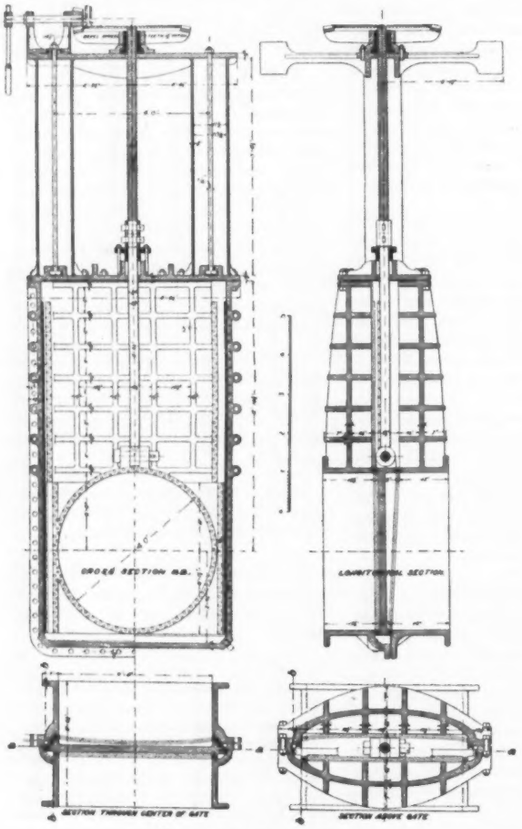
A FAST RUN was made on the Louisville, New Albany & Chicago Ry. this week by a special train from Chicago to Louisville. The run of 323 miles was made in 7 hours 15 minutes, an average of 44 miles per hour including stops.

A Standard 48-in. Stop Valve.

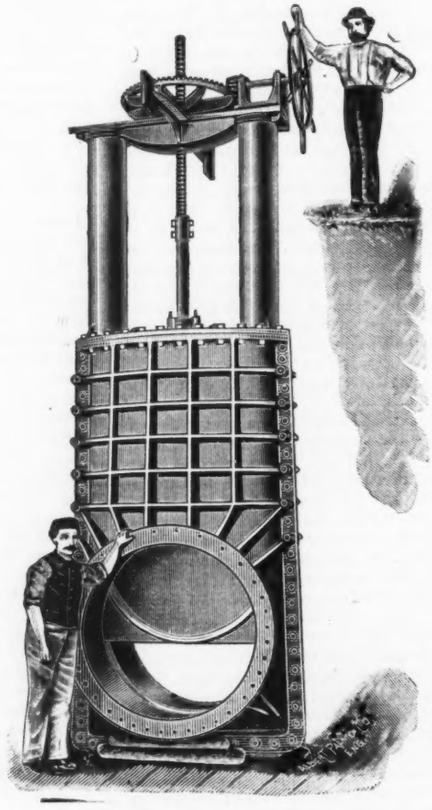
The accompanying drawings represent the most essential parts of the standard 48 in. stop valve used in the public works of New York City. The engravings show the valve as made by Caldwell, Wilcox & Co., of Newburgh, N.Y., for use at the 135th Street gate-house on the New Croton Aqueduct.

In these valves the seats are of composition formed of 6 parts of copper, 1 part of tin and ¼ part of zinc. The case, or body, of the valve consists of two castings flanged and bolted together, the upper part being strengthened by ribs 1⅛-in. thick. To each end of the cap piece is bolted a cylindrical standard ⅝ of an inch thick and 11¼ ins. outside diameter. On top of the standards is a cross piece held in place by 1¼-in. rods passing through the standards to the cap. The gate is of the usual wedge shape, one side being vertical while the other inclines at such an angle as to make the lower portion 5 ins. and the upper 8 ins. thick. The gate is operated by means of a square threaded screw 3⅛ ins. in diameter, provided at its upper end with a bevel gear having 76 teeth of 1½ in. pitch, with which engages a pinion of 13 teeth mounted on a short horizontal shaft having a hand-wheel at its outer end. This shaft is mounted in bearings formed in a casting held to the cross piece by the rod passing through the standard.

An interesting feature of the work on the aqueduct is the fact that all the iron used from Sodom dam to the 135th Street gate house, except that in the section under the Harlem river and the lining of shaft 25, has been furnished by the above named company. This includes valves and fittings, shaft linings and all structural iron.



Sections and Plans.



Perspective View.

Standard 48-in. Stop Valve on Public Works of New York City.

THE RAILWAY SYSTEM OF GREECE is likely to be considerably extended, as bills to be introduced during the new session of the Greek Chamber will include measures to further develop the resources of the country, and especially for increasing means of communication by constructing a network of railways in the Peloponnesus. A concession is also to be granted for the construction of a railway to Larissa, uniting Greece with a great European system.

The Drainage of New Orleans.

The drainage of the City of New Orleans is a troublesome problem, and B. M. HARROD, City Surveyor of that city, has sent to the Mayor and Councils an elaborate and seemingly well digested scheme for a permanent improvement in this direction, from which we make the following brief abstract:—

New Orleans is mainly built on the alluvial slope of the eastern bank of the Mississippi river, extending to Lake Pontchartrain, with a width of from 4 to 7 miles and a total inclination of 15 ft. from the river to the lake. But this inclination is almost exhausted in the first 2 miles, leaving as a remainder a level swampy plain broken by the Metaire and Gentilly ridges, about 2 miles from the lake shore and generally parallel to the lake. These ridges prevent the drainage of the city area directly into the lake.

The natural drainage of the city is thus along the depression existing between the high alluvial bank of the river and these ridges, until it intersects the bayou St. John discharging into Lake Pontchartrain; another part passes by the bayou Bienvenu into the Mississippi Sound. The development of this natural system should have formed the basis of all the city drainage works. But the strange result has occurred that while the Supreme Court has declared that bayou St. John is not a navigable stream, a private corporation has acquired the right to improve its navigation and the city has lost its right to use it for drainage purposes. This loss of privilege and the existence of other canals as commercial channels complicate the problem greatly; but any present scheme proposed must deal with present conditions.

Mr. HARROD then blocks out a scheme of gradual but progressive application, of which the leading features are as follows:

1. A survey to ascertain the exact relative levels of the area to be drained, the proportion of drainage to rainfall, and the character and capacity of the proposed outfalls.
2. Levees of sufficient strength and grade to afford absolute protection against floods in the river and lake.
3. Canals, sufficient in number and dimensions to receive and hold, as reservoirs, a large portion of the drainage and to conduct it to the drainage machines.
4. Drainage machines of proper number, power and location.
5. Intercepting canals, to receive the ordinary flow from the gutters during dry periods, and conduct it through Bayou Bienvenu to Lake Borgne; thus allowing only the surplus water of great rainfalls to be discharged into Lake Pontchartrain.
6. The rectification of the dimensions and grades of gutter bottoms, bridges, culverts, streets and sidewalks.
7. The extension of permanent and impervious pavements as rapidly as possible.
8. The extension of canals, similar to the Camp, Melpomene and Nashville Avenue, to other parts of the city, now insufficiently drained from the existence of local depressions or the distribution of the fall over excessively long lines of drainage. It might be desirable to execute a part of the work in the order of details Nos. 3 and 5.
9. The lining of the sides and bottoms of these and all other canals in populous neighborhoods, such as the Camp, Melpomene and part of Claiborne, with brick or concrete or other permanent material.
10. Providing means for flushing all canals.
11. The subsoil, or tile drainage of street and premises.

Mr. HARROD thinks the necessary survey could be made for about $10,000; The necessary levees are estimated at $156,000, and for digging new canals and cleaning and enlarging existing canals the estimate is 2,250,000 cu. yds. at 20 cts. per cu. yd., or $450,000. It is essential to drainage and sanitation that the water surface in these canals be kept down by pumping 6 ft. below the ground surface, and more if possible.

The present drainage plant is defective in design capacity and location. The total area of the city is 19,204 acres and 6 in. of rainfall upon this area represents 418,263,120 cu. ft. The volume of drainage from improved and unimproved land, in the proportion of 56 and 27 per cent., is 170,891,325 cu. ft. The remaining rainfall is assumed as retained by cisterns, absorbed by the soil and consumed by vegetation, Assuming the lift at 3 ft., the removal of this storm drainage once in 24 hours would require an aggregate of 674 horse-power, which could be concentrated to advantage at one pumping station for each of four districts. While the type of machinery required is

not discussed, the centrifugal pump is recommended, though it is more liable to injury than the ordinary wheel now used. As Hollanders undoubtedly have the most experience in this class of drainage, the following tabular statement of the types of water-raising machines there in use is significant :—

	1875	1876	1877	1878	1879	1880	1881	t't'l
Wheels	3	1	1	4	12	9	8	38
Centrifugal	1	1	6	6	11	9	16	50
Wheel and centrifugal combined	....	....	....	1	....	1	1	3
Wheel pump	....	....	....	1	....	1	....	2
Screws	3	1	....	2	12	4	1	30
Piston pump	....	....	1	1	....	....	2	4
Various	3	....	2	6	....	1	....	12
Total	....	....	....	....	....	....	....	139

On a basis of from $400 to $500 per actual horse-power, including foundations, machinery and buildings complete, the necessary pumping plant should cost about $365,000.

A rough estimate then for the whole scheme would be—surveys, $10,000; levees, $156,000; canals, $450,000; drainage machines, $365,000, or a total of $961,000. The proper grading of gutters and drains and permanent impervious street pavement are also all important essentials to complete the success of this project as a sanitary, commercial and social measure.

A Formula for the Mean Velocity of Flow in Sewers.*

In determining the sizes of sewers, we must know the relation between the mean velocity and the cross section and slope of the water. In exceptional cases it may be necessary to make special gaugings in order to find this relation under the conditions presented, but in most cases it is sufficient to use a general formula, with a fair approximation to accuracy. Such an one is Eytelwein's, Weisbach's, Darcy and Bazin's or Kutter's formula.

The results given by the latter are the most reliable, because its range of applicability is much larger than that of the others, and is particularly well suited for sewer work, because it considers the nature of the wetted surface. Yet it is too complicated for any but office use, where the diagram makes its solution easily.

By realizing the nature of the various terms in the formula, is possible to materially simplify it for a limited range of special application. How this simplification may be accomplished for general sewer work, avoiding even the use of the diagram, is shown as follows:

The original formula reads:

$$(1) \qquad v = \frac{41.6 + \frac{1.811}{n} + \frac{0.00281}{s}}{1 + \left(41.6 + \frac{0.00281}{s}\right)\frac{n}{\sqrt{r}}} \sqrt{rs}$$

in which:

v = velocity per second,
n = coefficient of roughness of wetted perimeter,
r = hydraulic radius,
s = slope of water surface.

The term $\frac{0.00281}{s}$, which occurs twice, can be readily eliminated by substituting for the value s the least grade that we are likely to have in sewers, namely 1:2500. Then we obtain the constant value:

$$\frac{0.00281}{0.0004} = 70.0$$ which reduces the formula to:

$$(2) \qquad v = \frac{48.6 + \frac{1.811}{n}}{1 + 48.6\frac{n}{\sqrt{r}}} \sqrt{rs}$$

This substitution influences the result but little. It tends to make the smaller sewers slightly larger than the original formula. There would be in fact no difference at all for a sewer about 13 ft. in diameter, whatever its grade; and the difference would increase, as the size diminishes and the grade increases, up to an excess of about 5 per cent. for a sewer of one foot diameter, at a grade of 4 ft. per 100. This excess of about 5 per cent. is practically the maximum error for sewer application, and it is always on the safe side.

We can, therefore, safely let it stand.

But the formula can still further be simplified by substituting a numerical value for n.

According to Kutter, for glazed pipe we would have to put $n = .010$. But owing to the frequency of joints and the imperfect shape due to the process of burning, which causes projections in the sewer at nearly every joint, it is not safe to assume so low a coefficient. Besides, the flow of sewage is slower than that of clear water, because the suspended matter drags at the perimeter and tends to hold the water back. Allowing for these causes, we generally get nearer the truth if for pipe sewers we put $n = .013$.

For brick sewers, on the other hand, Kutter gives $n = .013$.

It has been found, however, that if well built, n can often be reduced to .012. Still, for sewage flow the resistance is again greater, and I have found that by adopting the value of $n = .013$ also for brick sewers we are about as nearly correct as it is necessary to be in the majority of cases, and err slightly on the safe side, if we err at all.

By substituting this value in formula 2 we get:

$$(3) \qquad v = \frac{188}{1 + \frac{0.64}{\sqrt{r}}} \sqrt{rs}$$

or,

$$(4) \qquad v = \frac{188\ r\sqrt{s}}{0.64 + \sqrt{r}}$$

which is, therefore, not only a sufficiently accurate, but also a sufficiently simple formula for general use in sewer work, for which purpose I have used it since 1879.

Stated in general terms, the formula reads:

$$(5) \qquad v = \frac{A\ r\sqrt{s}}{B + \sqrt{r}}$$

By substituting the following values for the coefficients A and B, we can use it for any other degree of roughness than $n = .013$, as we may think proper in some cases.

Different Degrees of Roughness.	A.	B.
For = n 0.011, very smooth, with even joints	213	0.54
" = n 0.012,	200	0.59
" = n 0.013, average,	188	0.64
" = n 0.014,	178	0.69
" = n 0.015, poorly built brickwork, with washed out joints,	160	0.73

For *very* smooth and regularly shaped sewers we might say:

$$v = \frac{200\ r\sqrt{s}}{0.6 + \sqrt{r}}$$

which formula is easily remembered and easily solved.

The Graphic Traverse Table.

A diagram has been prepared by M. LORINI, of the Engineer's office of the Dept. of Public Works, Yonkers, N.Y., which is intended to assist engineers, surveyors and draughtsmen in their office work. It is sold at 50 cts. each. For many purposes it will take the place of more expensive tables in book form. It consists of a quadrant showing a series of concentric quarter circles numbered from 2 to 20, the spaces between these being further subdivided into ten parts. The lengths of the courses in a traverse are read off on these quarter circles. Angle lines are drawn for every fifteen minutes between divisions 10 and 20. Between 5 and 10 half degrees are are shown, and between 2 and 5, whole degrees. The space below 2 is left blank, as there is a better opportunity to get close readings between 10 and 20; vertical and horizontal lines starting from the left, and from the lower edge of the diagram, and terminating in the outer quarter circle, give the distances of latitude and departure. There are 20 of each of these lines, and the spaces between them are also subdivided into ten parts.

To get the latitude and departure of a course, find the point where the given length taken on one of the quarter-circles makes the proper angle with the first vertical or zero line at the left of the diagram. The vertical and horizontal lines meeting in that point will give respectively the latitude and departure of the course. It is possible to read an angle to two or three minutes, by using the needle point with which most drawing pens are furnished. The distances can also be read to one-hundredth of a foot on the scale of a diagram.

It is surprising how accurately one can work with the Graphic Traverse Table after a little practice. Thus, in a traverse of 23 courses, the sums of the latitudes and of the departures differed but 6-10 and 4-10 of a foot from the calculations made with a table of natural sines and cosines. This is certainly a good enough result for any check, or for plotting by co-ordinates. Again, the table will give the length and bearing of a missing course in a traverse and help to perform other calculations, for diagonals, slopes, stadia measurements, etc. As a help to rapid work, it is ahead of any other contrivance. A traverse of not less than 175 courses can be checked with it in one hour. Being printed on good paper mounted on muslin, 14 x 14 ins., it will last a long time and stand very rough usage. When not in use it can be rolled up and put away.

The Brunig Railway.

The new railway through this celebrated Alpine pass has been built and opened for travel during the past summer. It connects the Lucerne district with that of the Bernese Oberland, beginning at the village of Alpnacht, at the southwest extremity of the Lake of Lucerne, thence traversing a flat country and mounting by zigzags near Lungern to a height of 3,300 ft. above the sea level, then descending to the village of Brienz, on the other side. The line is at present worked in connection with steamers on the lakes, but will ultimately be extended from Lucerne to Berne. It follows closely the course of the carriage road and crosses the summit of the pass without a tunnel.

The railway is interesting for the necessary departures from ordinary railroad construction required on nearly all the Swiss roads, and applies the special engineering principles employed on such lines as the St. Gothard and Rigi roads, to a more moderate degree but on a larger scale.

At Giswyl, where the grade begins to rise, inclines are used equal to 12 per cent., or 1 ft. in 8, as compared with 1 in 40, the maximum grade allowed on the St. Gothard line and which is of course beyond the limits of ordinary traction. Here a toothed rack is laid between the two rails into which a gear wheel runs, driven by a locomotive, and which slowly forces the train up the incline. This apparatus can be thrown out of action where the grades are within the limits of ordinary traction, and the engine worked as an ordinary locomotive, by adhesion.

For additional brake power and safety on the steep inclines, each carriage is provided with a gear-wheel running in the rack-rail and is supplied with drums on the axle shafts, to which clip-brakes are applied.

In descending, these brakes are used to regulate the speed and can be screwed down sufficiently to hold the carriages at any point. The engine, which is placed at the front of the train, is also provided with a special pneumatic counter-pressure brake sufficiently powerful to control the whole train.

To obviate danger, should the couplings of the carriages break, an automatic arrangement is employed by which the brakes are always kept applied by heavy weights, which would render the carriages immovable, and which are lifted by steam power on starting up the incline, conveyed throughout the train in flexible tubes. If the couplings break, these tubes will break also and thus cause each carriage to be held. The gauge of this line is one metre.

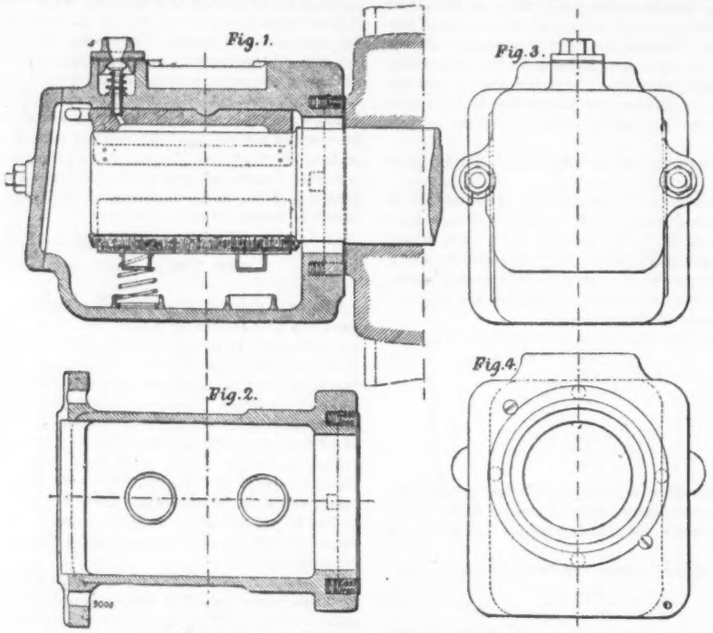
AN INDIAN RAILWAY 600 miles long is proposed by Sir THEODORE HOPE, late Minister of Public Works for India. It would extend between Chittagong and Dibrugarh and the cost is estimated at $30,000,000. The road would open up tea lands and make an outlet for the coal and oil of the Upper Assam valley. Chittagong is on the Bay of Bengal, and the line would run almost due north.

THE GRADE CROSSING QUESTION is being agitated in Lowell, Mass., but as yet to little purpose. A committee of the Board of Trade has reported in favor of raising the streets to go over the tracks, which is with justice regarded as impracticable. Attention is now attracted to the more rational plan of raising the tracks above the street level.

* By RUDOLPH HERING, from the Proceedings of the Engineers' Club of Philadelphia. Vol. VII. No. I.

Dust-Proof Axle-Box.

The illustration here given shows a dust-proof axle-box for railway vehicles invented by Mr. WILLIAM MACNEE, 2 Westminster chambers, Westminster, London, to prevent to a large extent the friction and wear of the brass which result from the entrance of gritty particles, mostly at that side



A Dust-Proof Axle-Box; Macnee's Patent.

of the box which is next to the wheel. There is formed in the side of the box next to the wheel a circular groove concentric with the axle, and in this groove there is inserted a ring of metal or alloy, with springs arranged in the groove behind it so as to press it outwards against the boss of the wheel. The engravings show four views of an axle-box of ordinary construction modified according to this invention.

Fig. 1, shows the box in section, and part of the boss of the wheel next to it. In the end of the box is a cast-iron ring pressed against the boss of the revolving wheel by springs. This ring is capable of moving to and fro with the wheel in the transverse oscillations of the axle, and forms a joint practically tight, which prevents access of dust or grit on the inner side of the axle-box, the outer side of which is closed by a cover and lid in the usual way.

In adopting this axle-box no alteration is required to the vehicle itself, as all the dimensions of the box can be made to correspond exactly with those of the box at present in use.

London *Engineering* says that several railway companies are trying the axle-box, while the Caledonian company has had all the carriages and the tenders of several of its express trains fitted with it for some months past, and has not had a single hot box. Nearly 10,000 boxes have been made.

The Retrocession of Niagara Falls.

From a recent paper by Prof. JULIUS POHLMAN, ex-president of the Buffalo Society of National Sciences, who has made a careful research into the geological and scientific history of Niagara Falls, we extract the following:

The first scientific survey of the Falls was made in 1842 by Prof. JAMES HALL, State geologist, and all exact knowledge dates from his maps. Prof. HALL gave the height of the American Fall as 167 ft. and of the Horseshoe Fall 158 ft. from the water's edge on Oct. 4, 1842, and admits that this starting point can vary from 4 to 20 ft. with the rise and fall of the water below the Falls. He gave the width of the American Fall as 600 ft. and that of the Horseshoe Fall as 1,800 ft.

The Lake survey went over the ground again in 1875, and in these 33 years the southernmost point of the Horseshoe Fall had receded 160 ft. while in the brink of the American Fall differences of 40 ft. were apparent.

When the American Association for the Advancement of Science met here in 1886, the section of geology decided to make Niagara the problem of the session, and for that purpose Professor WOODWARD, of Washington, and some of his assistants surveyed the brink of the falls again. They found an average recession for the whole face of the Falls of about 2½ ft. per annum, but as the central parts of the curve, where the water is deepest, retreated faster than the edges, the southernmost point of the Horseshoe Fall was found to have traveled south about 200 ft. since 1875, or about 300 ft. since 1842, nearly 9 ft. every year. In view of such rapid changes it seems highly probable that the older pictures of the Falls, which always place the Horseshoe Falls considerably nearer than they are to-day, are practically, or at least partially correct.

If the rate of retrocession remains during the next 500 years as it has been for the last 45 years, the inner edge o the Horseshoe Fall will have passed to the east of Goat Island, and as the line of deepest water is near the Canadian shore, all the waters of the river will pass over the Horseshoe Fall, obliterating the American Fall entirely and transforming Goat Island into a peninsula, on which the smaller islands of to-day, Bath, Luna, Chapin, etc., will appear as little hilltops.

The fall will then be higher than to-day because the present descent of 50 ft. over the rapids will be added to the height of the cataract, minus the number of feet needed to give the necessary current to the river below, which at present is 15 ft. per mile. Considering that even now the Horseshoe Fall no longer recedes south but more east than south, which recession will be more easterly yet in the course of time, it will have to travel about 5 miles in that direction before the Niagara shale, which now occupies the lower half of the face of the fall, is under water; and the retrocession by means of undermining is stopped. For at present the changes that take place are due to the fact that the upper 80 ft. of the face is formed of a hard limestone, while the lower 80 ft. is composed of soft, easily crumbling shale. Then the changes will be accomplished simply by the eroding power of the water and the Falls will remain near the northern end of Grand Island for a practically unlimited time. We thus see that after the Falls of to-day have receded, perhaps three-quarters of a mile, there will be only one Fall; when that one Fall has traveled east and south four miles more and reaches Grand Island, it will be again divided into an American and a Canadian cataract, this time separated by Grand Island, and, like the Falls of to-day, the western branch will carry the largest amount of water, will recede faster and be the lower of the two in height. The hope of finally having the Falls at Buffalo must be abandoned, for from that point of Grand Island to the city of Buffalo only rapids can exist on account of the nature of the underlying rock, which is soft.

As the retrocession of the Falls of Niagara began in what may be called, geologically, the most recent period the time necessary for it to arrive at its present site has had a very important bearing upon the question of the age of man on the American continent. As long as it was considered necessary to claim several hundred thousand years for the age of Niagara alone, the age of the human race had to be computed at perhaps half a million of years. But since we have discovered that the work of excavation could have been accomplished in perhaps 3,000 years, our computation of the age of the human race has settled down to reasonable figures, which give to the beds of sand and gravel in which the oldest human implements have been found, an age of perhaps 40,000 to 60,000 years, and anthropologists claim that all the facts so far collected agree well with the latter figure.

Land Below the Level of the Sea.

From an interesting paper which appears in the *Citrograph*, Redlands, Cal., we extract the following:

In the eastern part of San Diego Co., about 100 miles from Los Angeles, is a depression traversed by the Southern Pacific railroad, known to geographers as the San Felipe Sink, but commonly called—on account of the innumerable shells spread over its surface—Conchilla valley.

Dr. J. P. WIDNEY, while surgeon in the United States army, crossing this region with troops 21 years ago, noticed surrounding this territory a well-defined line along the mountain sides, always at the same level. Above that line the rocks are sharp and jagged, showing that for ages the water had stood at that level. He says, "I found it to be the old beach of a sea". I find nothing else noted of this country until the surveying party of the Southern Pacific railroad, in running the line from Los Angeles to Yuma, found that sea level was at the point where Dr. WIDNEY had noted the ancient beach. They then gradually descended to the south until they reached a depression of 268 ft. below sea level, at a point near Salton. This basin is about 130 miles in length by 30 miles in average width. The deepest point is about 360 ft. below sea level.

At Salton, the surface of the earth for nearly 10 miles square is covered with a crust of salt from 4 ins. to a foot thick. In midsummer the mercury indicated 105° F. in the shade but out in the sunshine, with the dazzling reflection from the glistening surface that extended for miles on each side, the temperature was probably 130° F. but the workmen out in this peculiar harvest field suffered far less from heat than is to be seen, ordinarily, in July, in the wheat fields of the Mississippi valley. The low relative humidity explains the total absence of sunstroke here. There are extensive mills here for grinding the salt. It is not put through any system of purification, but, after grinding, proves to be excellent for table use. Several hundred tons are thus prepared every month and shipped.

A few miles east of here are the famous mud volcanoes, which are equal in wonder to the geysers of this state. Owing to the treacherous character of the ground around them they have never been thoroughly examined. Professor HANKS, the State mineralogist, undertook it, but breaking through the crust he was so severely burned that he was compelled to abandon his investigations. Here is an extensive, almost unexplored, field for some adventurous scientist.

Indio is the principal station in the valley, and is near the northern rim of the basin, being only 20 ft. below sea-level. The sandy plains around were formerly considered a hopeless barren waste, but the advent of the railroad has made great changes. Good water is supplied by surface wells; but in order to have water for irrigation, artesian wells have been bored. There is one 2¾ miles east of Indio that is now flowing 1,000 galls. per hour. This flowing water was reached at a depth of only 115 ft., after boring through layers of sand, clay, sand, tough blue clay, clay, coarse gravel, clay and sand. Oranges and various other kinds of fruit are being grown here, and there are in this vicinity about 40,000 acres of excellent land.

In this valley live about 400 of the Cohuilla Indians, supposed to be of Aztec origin. They are sun and fire worshipers, believe in the transmigration of souls, and practice cremation.

Among other places below sea level are the sink of the Amargosa (Arroyo del Muerto), in Eastern California, 225 ft. below sea level. The Caspian Sea is 85 ft. below sea level. Lake Assal, east of Abyssinia in the Afar country, 8 miles long and 4 miles wide, is about 760 ft. below sea level. Its shores are covered with a crust of salt about a foot thick. There are several other depressions about 600 ft. below sea level in this vicinity. The noted oasis, Siwah, in the Libyan desert, 300 miles west of Cairo, is 120 ft. below sea level. In this same desert is the oasis Araj, 266 ft. below sea level. There are also numerous other depressions in the desert portion of Algeria and at various points on the Sahara Desert. The Dead Sea, 46 miles long and 5 to 9 miles wide, is 1,308 ft. below sea level, being the deepest known to exist.

TO PROVE THAT THE EARTH REVOLVES.—A German educational journal, published in Frankfort, gives the following directions for proving that the earth "does move": Take a good-sized bowl, fill it nearly full of water, and place upon the floor of a room which is not exposed to shaking or jarring from the street. Sprinkle over the surface of the water a coating of lycopodium powder—a white substance, which is sometimes used for the purposes of the toilet, and which can be obtained of almost any apothecary. Then upon the surface of this coating make, with powdered charcoal, a straight black line, say an inch or two in length. Having made this little black mark with the charcoal powder on the surface of the contents of the bowl, lay down upon the floor, close to the bowl, a stick or some other straight object, so that it will be exactly parallel with the mark. If the line happens to be parallel with a crack in the floor, or with any stationary object in the room, this will serve as well:

"Leave the bowl undisturbed for a few hours and then observe the position of the black mark with reference to the object it was parallel with. It will be found to have moved about, and to have moved from east to west—that is to say, in the direction opposite to that of the movement of the earth on its axis. The earth in simply revolving has carried the water and everything else in the bowl around with it, but the powder on the surface has been left behind a little. The line will always be found to have moved from east to west, which is perfectly good proof that everything else has moved the other way."

Thickness of Plates for Stand-Pipes.**

Assume: Wrought Iron Plate T. S. 43,000 lbs. in direction of fibre, and T. S. 45,000 lbs. across the fibre.

Strength of single rivetedjoint, .4 that of the plate, and of double riveted joint, .7 that of the plate.

Wind pressure, = 50 lbs. per sq. ft.

Safety factor, = 3.

Let h = total height in feet; r = outer radius in feet; r' = inner radius in feet; p = pressure per sq. inch; t = thickness in inches; d = outer diameter in feet.

Then for pipe filled and longitudinal seams double.

$$t = \frac{p\,r \times 12}{48{,}000 \times .7 \times \frac{1}{3}} = \frac{h\,d}{4301};$$

and for pipe empty and lateral seams, single riveted, we have by equating moments:

$$50 \times 2\,r\left(\frac{h}{2}\right) = 144 \times 6000\,(r^4 - r'^4)\,\frac{.7854}{r}$$

whence

$$r^4 - r'^4 = \frac{h\ r}{27144}.$$

TABLE SHOWING REQUIRED THICKNESS OF BOTTOM PLATE IN INCHES.

Height in feet.	Diameter.					
	5 feet.	10 feet.	15 feet.	20 f eet.	25 feet.	30 feet.
	ins.	ins.	ins.	ins.	ins.	ins.
50	+ 7-64 *	1-8 *	11-64*	15-64	19-64	23-64
60	+ 11-64 *	9-64 *	7-32	9-32	23-64	27-64
70	+ 7-32	11-64 *	1-4	21-64	13-32	31-64
80	+ 19-64	3-16	9-32	3-8	15-32	9-16
90	+ 3-8	7-32	5-16	27-64	17-32	5-8
100	+ 29-64	+ 15-64	23-64	15-32	37-64	45 64
125		+ 23-64	7-16	37-64	47-64	7-8
150		+ 33-64	17-32	45-64	7-8	1 3-64
175		+ 11-16	39-64	13-16	1 1-32	1 7-32
300		+ 29-32	45-64	15-16	1 11-64	1 25-64

*For reasons not considered here, the minimum thickness should = 3-16 ins.

N. B.—Dimensions marked + determined by wind pressure.

Asphalt Pavements in Berlin.

Mr. RUDOLPH HERING, C. E., is authority for the statement that the load which one horse can draw on an asphalt pavement, will require two horses on the best Belgian block, three horses on ordinary Belgian block, five and one-fifth horses on good cobble-stone and seven and four-fifths horses on bad cobble-stone.

Assuming that this calculation is scientifically correct, and we have no doubt it is sufficiently accurate for practical purposes, if the streets of our cities possessed a good well-laid and well-kept asphalt pavement the number of horses now in use might be largely reduced and a considerable saving effected. That the laying of good asphalt pavement presents no longer any difficulties, is proved by the trials at Berlin which the department of public highways has caused to be carried on with the usual thoroughness of the Germans during recent years. According to the Municipal report published a short time ago, the first trials with asphalt pavements in Berlin were made in 1873, the asphalt being procured from the famous mines of Val-de-Travers, Canton Neuchatel, Switzerland. These trials having yielded satisfactory results, the city, in 1877, contracted for an area of 3,000 sq. yds. to be covered with asphalt. At the end of 1878, the network of asphalt paved streets amounted to,

At the end of	1868	28,000 sq. yds.
"	1880	127,000 "
"	1882	224,000 "
"	1884	386,000 "
"	1886	494,000 "
"	1887	564,000 "
on July 1,	1888	655,000 "

These figures sufficiently attest that asphalt pavements there are rapidly and steadily growing in favor with the authorities as well as with the public, and that their disadvantages as urged on some sides, cannot be of a very serious nature. A petition praying for the general extension of the system of asphalt paved streets and addressed to the Chief Magistrate of the city, was signed by 1,500 owners of horse teams and vehicles of all descriptions, representing in the aggregate 14,900 horses.

**By KENNETH ALLEN in Proceedings of Engineers' Club of Philadelphia. Vol. VII. No. 1.

The first cost of 1 sq. yd. of asphalt pavement in Berlin is, on the average, $3.50, the cost of maintenance for a period of 20 years being fixed by contract at $1.50. The total cost to the city of 1 sq. yd. of such pavement for a period of 20 years, is therefore only $5, which is but 15 cts. in excess of the first cost of a square yard of the best Belgian block pavement. It should also be mentioned that about 40 per cent. of the first cost of asphalted roadway in Berlin is due to *freight* charges, the raw material being transported all the way from Switzerland.

The complaints about the slipperiness of asphalted streets causing numerous accidents to horses, which were heard largely in the beginning, have gradually ceased, for two reasons, viz.: first, the department has devoted incessant care to their treatment, studying the peculiarities of the roadway in all kinds of weather and keeping it always well cleaned. Second, horses have become accustomed to the smooth pavement, and drivers are more careful to guard their horses against falling when they do slip. Statistics kept by the department show that while in 1885 the number of fallen horses, as nearly as could be ascertained, was 4,403 upon an area of 398,000 sq. yds. this number decreased to 2,456 in 1887 when the total area amounted to 485,000 sq. yds. Thence we have for 1885 one fallen horse for every 87 sq. yds. for 1887 one for every 198 sq. yds. of asphalted roadway, an improvement of 225 per cent. During the first six months of the current year, a further improvement has been noted in this connection.

The force required to keep the streets clean is smaller and less expensive than one would suppose. In 1887 this body was composed of 45 youthful laborers, who with tools of various kinds, specially constructed to meet the requirements of their work, succeeded in keeping the roads in a perfect condition, at the rate of 11,000 sq. yds. per head.

The only atmospheric condition unfavorable to asphalted roads has been found to consist in heavy fogs attended by a fine drizzling rain. In such weather, a soaplike, slippery mud is produced upon the asphalted surface which is, however, easily removed by copious washing off with water. Statistics have also brought out the fact that horses falling upon an asphalted road seldom sustain injuries, whilst the danger of serious injury is considerably greater by a fall upon a block pavement.

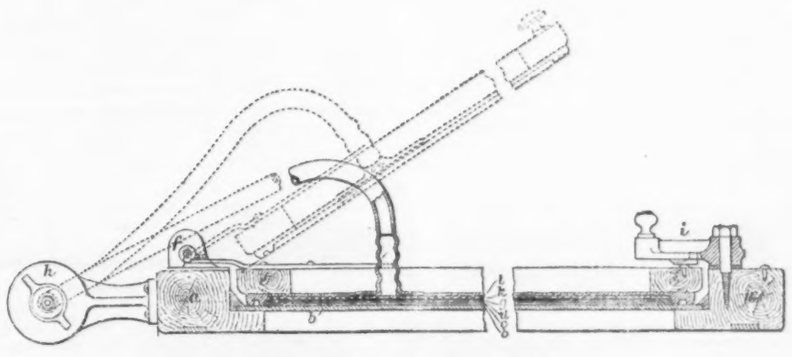
That the asphalting of streets is rendering valuable service to a city, considered from a hygienic point of view, cannot be questioned. The asphalt cover forming an impenetrable layer, prevents the impregnation of the ground with impurities from above as well as the rising of miasmatic exhalations out of the ground. Wooden block pavements, preferred in some cities to stone pavements, remain damp long after the stoppage of rain; they absorb the urine of horses, and other impurities, thus forming a breeding ground for disease. The considerable lessening of the noise in the streets caused by the vehicles, the saving accruing to horseflesh, as well as to vehicles of all kinds, due to the avoidance of all jolting, and finally, the neat and pleasing appearance of asphalted streets are additional advantages which should induce our street departments to engage in some experimental undertaking on a large scale which it is hoped, may lead to the general adoption of asphalted roadways in our cities.

Stretching Blue-Prints by Air-Pressure.

HUGO LACK, of Duisberg, Germany, is the inventor of an ingenius and simple pneumatic blue-print frame described and illustrated in a late number of *Engineering*. It is manufactured and sold by SCHLEICHER & SCHULL, Duren, Rhenish Prussia.

In the accompanying cut, a is the usual blue-print frame; b, the glass; c the negative and d the sensitized paper. Above this is a light frame e, hinged at f, and carrying on its under side an air-proof sheet of a rubber fabric l with thickened edges and two joint strips. Inside the shallow recess thus formed is a loosely woven cloth k glued to the edges of the rubber sheet, and over this is a smooth sheet of pasteboard in direct contact with the back of the sensitized paper.

The rubber sheet has a small hose-pipe connected with a simple air-pump h, consisting of a small barrel and piston fitted to the frame so as to do service as a handle. This frame is operated as follows:—When the negative and printing paper have been placed as usual and the frame clamped down, the air is exhausted between the glass and the rubber sheet and atmospheric pressure brings about the necessary close contact of negative and sensitized paper, and the loose cloth furnishes air passages over the entire surface and prevents local bulging or puckering. There is no strain on the glass and sharp, excellent prints result from the use of this ingenious appliance.



Pneumatic Blue-Printing Frame.

Railways in Yucatan.

The following interesting particulars are taken from a report by EDWARD H. THOMPSON, U. S. Consul at Merida, Yucatan.

The Merida & Peto Railway, owned by RUDOLF CANTON and OLEGARIO G. CANTON, is one of the best built lines and may be considered a typical railway of Yucatan. The concession was granted May 27, 1878, and the first rail laid a year later. The road is 3 ft. gauge, well built, and ballasted for the most part. The rails are of Bessemer steel, 40 lbs. per yard, purchased in England; they rest upon cross ties of "chu-cum," a wood as hard and heavy as lignum vitæ, spaced 2 ft. apart, 15 to each length of rail. There are 4 locomotives, purchased in the United States, 5 passenger cars and 22 box and platform cars. Upon the length of 42.16 miles now in operation, there are 8 stations, built of stone and mortar, well kept and of neat appearance. The cost of construction is low, owing to the level nature of the country; Mr. THOMPSON knows of but one natural depression necessitating a fill of over 25 ft. on any of the 5 railways. The rocky plane that mainly covers the populated part of the country is of recent formation, being of 80 ft. calcareous rock, and the road builders sometimes break through into caves or "cenotes" formed by percolating waters and other causes; these caves are of varying magnitude and are covered with crusts of various degrees of thickness and strength. On the Merida & Peto Railway, while cutting through a small hill near the station of Hunabchen, a blast opened the mouth of a gulf below, which luckily proved to be comparatively small and shallow, and with much labor was filled sufficiently to allow the work to proceed.

TABLE A.—RAILWAYS OF YUCATAN.—CONSTRUCTION DATA.

Ultimate terminal points.	Constructed.	Rails (English steel) wt. p. yd.	Government subventions. p. mile (gold)	
			National.	State
1. Merida and Progreso..	24 mil's	60 lbs.	$ 89,525	1,900
2. Merida and Solutа.....	30 "	60 "		
3. Merida and Peto.....	43 "	40 "	1,192	7,152
4. Merida and Celestum..	27 "	40 "	"	"
5. Merida and Valladolid.	22 "	40 "	"	"
Conkal and Progreso	19 "	40 "	"	"

The first two lines are standard gauge; the last four 3 ft. gauge.

* The Merida & Progreso,4 ft. 9 ins. gauge, being the first railroad constructed in Yucatan, received a definite sum from the State upon the completion of the road. The roads constructed afterwards received from both State and National governments a stated sum for every kilometre completed. The "subvenciones" due the above-mentioned Merida & Progreso Railway have now been paid in full. The other roads have not as yet been paid the full amounts granted them, but the payment is believed to be only a question of time.

All rolling stock, except one locomotive on line 1, was purchased in the United States. Total equipment of all the lines, 17 engines, 26 passenger cars, 89 freight cars.

Spring Rail Frog; Penna. Steel Co's Pattern of 1888.

The pattern of frog here illustrated combines improvements of the highest importance, and for main line tracks it is claimed to be the best, safest and most economical frog extant. This claim is based upon the following points:— In this pattern of frog the spring rail is guided, and kept in place by the strongest and most efficient devices in use, the spring rail being strengthened and secured against breaking. The peculiar form of the spring rail provides for all condition of wheels, the most secure and effectual bearing and support ever attained in spring frogs. The fixed parts are tightly bound together inside of strong clamps, which are so interlocked and secured that they cannot work out of place, are much stronger than any other means of fastening the parts, and may always be tightened, as the parts wear, so as to keep everything snug and solid, and avoid rattling. The improvement may be described in detail as follows:—

Spring Rail, Improved Form.—The rail on the turnout side has part of the flange removed, on the inside, and is shaped to fit close against the frog point for a considerable distance, so that all the wheels moving on the main line track are supported and carried over the same as on an unbroken rail. Springs press this rail (called "spring rail") closely against the frog point, but allow the backs of the wheel flanges to crowd it away from the frog point, whenever the cars pass on that side, to go into or out of the siding. In the improved "Patent Keyed Spring Frog" the spring rail is made longer than the fixed wing rail, and extends along the point farther than in previous spring frogs, so that the "extra flanges" of guttered wheels of locomotives *trailing* over the frog (i. e. from "heel to point",) are certain to get *on top* of the spring rail as they pass over the point; there being no space between the point and the spring rail, when the wheel reaches the part of the point that is narrower than the gutter, into which the "extra flange" would drop if not supported by the spring rail.

Improved Spring Rail Guide and Reinforcing Bar.—To prevent the end of the spring rail from flopping up, when the weight is on the other part of it, a very strong guide arm or slide is secured on the side of the spring rail and extends into an open guide box, that is riveted on an iron slide plate which extends under the frog, and is spiked with several spikes to the tie. See Figs. 4 and 7. The open guide box is so shaped and placed that it also stops the (outward) movement of the spring rail, at the proper distance for the passage of the wheel flanges going to or from the siding. The guide arm or slide is made of a long bar of iron ¾ inch thick folded together to form an arm, with the ends bent straight back to fit the spring rail. That portion being planed to fit the rail as a splice bar, is secured by ¾ inch bolts on the side of the spring rail, and covering as it does that portion of the spring rail which has been somewhat weakened by removal of the flange (on the inside, to make it fit closely against the point of the frog) it reinforces the spring rail, and makes it secure against breakage at the weak place. At a slight additional cost for increasing the length of this bar, it may extend the whole length of the spring rail, and ensure prevention of accident from breakage of the spring rail at any place.

Improved Spring Arrangement.— The springs are encased and applied to the free end of the spring rail by making the guide box, (a strong malleable iron casting, which limits all movements of the spring rail, in connection with the guide arm) with spring pockets on each side of the open division in which the guide arm of the spring rail extends. See Figs. 6 and 7. The effect of the springs is applied to the end of the guide arm by means of a stout bar and the bolts which pass through the springs into the nuts on the ends of the springs, and springs are regulated by screwing the bolts in or out. The power of spring required to hold the spring rail in place, is much less than with the old arrangement, of springs applied in front of the point, and there is less liability of the spring fixtures being injured.

Mode of Fastening.—As shown in Figs. 2, 3 and 5, the fixed parts of the frog are bound together inside of heavy wrought-iron clamps, by tapering keys or wedges driven between the clamps and the other parts. The clamps are bent over forms which secure uniformity of shape, and the keys are forged in dies of exact shape. Outside of the rail are iron blocks that fit the rail perfectly, and leave a small space, of uniform bevel shape, (between block and clamp,) into which the suitably beveled keys are driven, with heavy sledges. The parts are forced together very solidly, by the draw of the keys, and are held by the clamps with a strength of material greatly in excess of any number of bolts. The keys being split, the small ends projecting beyond the the clamps are spread open to prevent the keys from working back, and the edge of the rail flange projecting under the keys prevents them from working down. As shown in Fig. 5, the inner ends of the clamps are notched on the edges to interlock with the sides of suitable notches in the flange of the frog point, to prevent them from working down or shifting. The outer ends of the clamps are secured from shifting by clips riveted under the rail flanges. The point and the fixed wing rail are kept apart, for the flange-way, by accurately fitting iron blocks, of shape to avoid wheel flanges striking them. Dowels in the web of the rails project into the blocks and prevent them from shifting. The steel rails composing the point are fitted wholly by planing, (no application of heat to draw the temper), and riveted together.

The Pennsylvania Steel Co., of Steelton, Pa., can furnish these frogs of any desired angle or spread and of any practical length, but the standard length is 15 ft. For the length of the point 8 ft. from the heel to the half-inch point is recommended for use with suspended joints, and 7 ft. 4 ins. where joints come over ties.

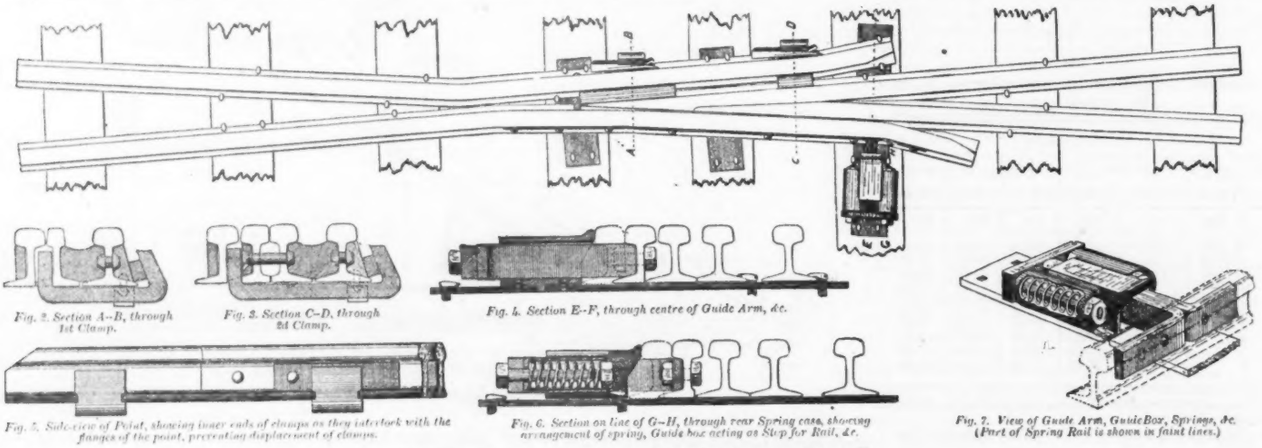


Fig. 2. Section A–B, through 1st Clamp.

Fig. 3. Section C–D, through 2d Clamp.

Fig. 4. Section E–F, through centre of Guide Arm, &c.

Fig. 5. Side view of Point, showing inner ends of clamps as they interlock with the flanges of the point, preventing displacement of clamps.

Fig. 6. Section on line of G–H, through rear Spring case, showing arrangement of spring, Guide box acting as Stop for Rail, &c.

Fig. 7. View of Guide Arm, Guide Box, Springs, &c. (Part of Spring Rail is shown in faint lines.)

Spring Rail Frog; Pattern of 1888; Penna. Steel Co.

The Canadian Pacific Railway.

VI.

MONTREAL TO WINNIPEG.

In the whole of this long eastern half of the Cadadian Pacific there is much less than on the Western half of what is called distinctly "engineering interest." No great monumental structures occur on the line; no very difficult or excessively heavy work occurs (although there is a great deal of what may justly be called heavy work); no strikingly unusual features of any kind are met with. Its interest is in the history of its rapid construction, the more remarkable features of which we have already told; in the manner and spirit of its administration, and in the character and history of the country run through. That a more than usually enterprising and liberal management guides the enterprise is evident from the very start, in Montreal, where terminal arrangements of quite unusual magnitude and excellence, which have been already described and illustrated in these columns, are now in a forward state of preparation. A magnificent terminal building in the very heart of the city, designed by Mr. BRUCE PRICE, of New York, and built of the fine grey limestone used for almost every building in Montreal, and which has given the city its unusual air of solidity and permanency, is now nearly ready for use. Although by no means the largest, it is beyond question, we take it, architecturally the finest railway terminal on this continent, and reflects the greatest credit on the architect (who also designed the much admired bay-window parlor cars of the Pennsylvania railroad) and on the management which engaged him.

Starting from this terminus, the line will run for nearly a mile, when completed, over the elevated masonry arcade illustrated in our issue of March 3 and 17, 1888, being the first line on this continent to adopt such a rational and really economical method of entering a large city. For the present only about a third of a mile of this approach will be con-

structed in stone. Beyond that point, permanent masonry piers to carry plate girders over the streets have been built, and the intervals between the streets filled in with very solid and substantial wooden trestles founded on piles. The location chosen for effecting this entrance was a favorable one, being along a steep bluff 60 to 100 ft. high which runs through the heart of the city parallel with the St. Lawrence river, being undoubtedly a relic of a once higher level of the river, and which runs unbroken (as do one or two others) for several miles above the city, to where the St Lawrence river is crossed by the great Lachine bridge, which formed so striking a contrast in weight, cost and time of construction to the old Victoria bridge a few miles below, once the pride of Montreal. That bridge, by the way, has been cut away at the top to do away with its intolerably bad air and darkness, and with the tendency to rapid corrosion caused by the confined locomotive gases. It is still a very disagreeable bridge to pass over, and obstructs a very beautiful view of the city and river. With the increasing cheapness of iron, it is probably only a question of time when it is removed and a modern structure put in its place on the same piers, which bid fair to last forever, and certainly look as if they ought to. The weight of the Victoria bridge, to the best of our recollection, is over five times that of the new Lachine bridge (the cost was about 6¼ times as much) and it is said that an offer was once made to renew it in return for the old iron in the old bridge. Certainly there is nearly enough iron in it to warrant this; but it was none the less, in its day, a triumph of engineering.

At present the Canadian Pacific trains leave from a station at the easterly end of the city, involving an almost complete circuit of it, and so losing several miles of distance. The main line trains, of course, do not cross the St. Lawrence bridge, which is only for the eastern and southern business of the line.

It is not only in passenger terminals that the Canadian Pacific has done good work. The freight terminals also, although not yet all completed, are planned on an extensive scale. Two large elevators, 210x80 ft., holding 560,000 bu. each, have been erected, another is soon to be added, and more doubtless will be in time. Those already built embody all the latest improvements, and have many interesting features which have been fully described in a paper by Mr. STUART HOWARD, C. E., Engineer in Charge, under P. ALEX. PETERSON, C. E., before the Canadian Society of Civil Engineers (April, 1887) which we shall republish in substance next week, and will therefore only add now that the bins are 12 ft. square, each being supported on a masonry pier. The load per pier is 497,000 lbs. equal to 70 lbs. per sq. in. (10,080 lbs. per sq. ft.), or 55,222 lbs. per pile. The piles were driven by a 1,400 lb. hammer falling 20 ft., which seems a rather light blow for modern practice. The penetration we cannot state. The piles penetrate 9 ins. into a 2 ft. bed of concrete as will appear in the section to appear next week. There are 80 of these piled piers in all, with 9 piles per pier. Comparing the foundation pressures, the Bismarck bridge and Niagara cantilever have about 40 lbs. per sq. in. foundation pressure, or 5,760 lbs. per sq. ft. and the Capitol at Albany 166 lbs. per sq. in. or 13,900 per sq. ft., the latter on clay.

The location of the Canadian Pacific from Montreal for 802 miles to Heron Bay, where the north shore of Lake Superior is struck, presented no great difficulties, although it included much heavy work, owing to the fact that the rock is everywhere near the surface; which is much broken in detail although having few or no grand elevations. The coating of soil is extremely thin, and over a large portion of the area wholly wanting except in the pockets and depressions of the rocky surface which was for ages subjected to glacial and other ice action, and denied that gradual erosion by rain and water which has coated the primeval rocks of the regions of the south with so thick a coating of soil gravel, clay, and sedimentary formation. As another effect of this difference of conditions, lakes of all sizes and shapes abound throughout British America to an extent which is quite incomprehensible without seeing it. For hundreds of miles together between Ottawa and Winnipeg there is hardly a point from which one or two little lakes are not in sight, many of them filled with islands and of great beauty. From a practical point of view, however, they are merely a nuisance in the building of railways or subsequent development of the country, although they were a great convenience to the Indians and early French explorers, since they furnished wonderful water ways in almost every part and every direction throughout Canada, by which, with short portages between the lakes and rivers, journeys by canoe could be made from almost anywhere to anywhere. The records of these early journeys, which were largely over the very route now traversed by the Canadian Pacific, are full of romance and historic interest, as we had intended to show by some notes as to a few of them, but we find we must forbear. In part these lakes were large enough to be useful for transportation during the construction of the railway, but for the most part their only effect was to introduce much curvature, and compel the line to follow for miles together abrupt rocky shores.

As another natural effect of the conditions stated, it was almost impossible to make fills by borrow, and of course out of the question to make them by balancing cuts and fills, with cuts in rock. Hence a large amount of temporary trestling (which might well have been still larger at points) was required, to be filled in later by train. These trestles, and some others of the minor construction details, we will not now describe, as we have drawings of them to appear shortly. They are well and solidly built and are now being rapidly filled in.

As for the "development of the country" passed through on this long stretch, perhaps the less said about it the better. For 120 miles out of Montreal, to Ottawa, up the lower Ottawa, the valley passed through is a very good and rich one, but it is only a few miles wide. The valley heads nearly due west and is very straight (a fact to which we shall refer later) but to the north of the mountains which bound it, the country is merely a barren, rocky wilderness, except in a few narrow valleys. There is some good timber there, and no doubt minerals, but nothing to lead more than a handful of people to inhabit it as yet.

West of Ottawa for 200 miles more the valley is followed, and is of the same general character, only less so. The soil gradually becomes thinner, and the settlements likewise. The line then leaves the river (or rather the river leaves the line, since it turns abruptly north), and shoots across a remarkable natural portage to North Bay on the north shore of Lake Nipissing, a great body of deep water which empties by the French river into Lake Huron. The divide is only some 2 miles long and 30 ft. high between Lake Nipissing and a series of little lakes which empty directly into the Ottawa, constituting the remarkable opportunity for a great ship canal, which we briefly alluded to editorially, Oct. 13, and which is certain hereafter to attract great attention, since it would at very small cost admit the largest ocean steamers into the great lakes, and practically transforms Chicago, Duluth and all other lake ports into ocean ports.

With the exception noted, there is a continuous water channel in a nearly due east and west line between Montreal and the head of Lake Huron, nearly half of which is navigable as it stands for vessels of 28 to 30 ft. draft, and 400 miles shorter than that *via* Lake Ontario, which is almost hopeless to make passable for deep draft vessels. The banks being everywhere rocky and abrupt except on the lower Ottawa, by some 20 or more rock-fill dams, and some deepening of channel near Montreal, the whole of it can be made navigable for vessels of 28 ft. draft, without any canaling proper except through the short divide and for locks to pass the dams; constituting one of the most remarkable natural opportunities for a ship canal to be found on the globe.

Had the route lain through American territory, or had the ports to be benefited been chiefly American instead of chiefly Canadian, it would long since have been constructed, the necessary cost being very moderate, and the only objection, that for about five months in the year it would be closed by ice. As it is, even the possibility is hardly yet known; the only attention the route has had having been a reconnoissance for a canal of 12 ft. draft made years ago for the Government, which showed that such a canal could be built for some $12,000,000; but which it was rightly concluded was not worth while. Now that locks of 30 or 35 ft. lift instead of 10 or 12 ft. lift, are known to be practicable; and cheap rock-fill dams instead of the more costly and less durable and serviceable masonry or crib dams, a sum much less than double that would probably suffice to give 28 ft. draft from the Atlantic Ocean to Lake Huron and Lake Michigan, and thence without much further work to Lake Superior and Lake Erie. Chicago alone would find such a route a cheap investment at the price. As we hope to give hereafter fuller details with illustrations of this remarkable route, (which has a summit level of some 70 ft. only to overcome) we will say no more now. The days of small canals are nearly over, but the days of large canals, navigable by all but the largest ocean going vessels, are but just beginning.

Beyond North Bay, 364 miles from Montreal, the settlements grow rapidly thinner, and the available agricultural land less, soon ceasing altogether. Over the entire remaining distance to Winnipeg, 1,423 miles from Montreal, there is practically no agricultural land of any value. Around Port Arthur, the new Canadian port which the C. P. R. has called into being, there is a little, but only a little, up to within 10 or 15 miles of Winnipeg where the vast fertile plains of Manitoba begin. The soil which ought to be on the whole intermediate region, one is almost tempted to believe, has been carried off bodily by ice and water and dumped on the States south of the lakes, for there is nothing in the United States to compare with the general bareness and barrenness of the surface, even in the heart of the Alleghenies. Even the timber on this vast region, so far as can be judged from the railway, is practically worthless except for local use; being for the most part a scrawny and stunted growth. The potential resources of this region are ice, rock and minerals, but the last two, at many points, are of superlative quality, and it would seem must eventually lead to a considerable scattered population. The nature of this vast interval is but little understood in the United States, and constitutes an important element in the probable future of Canada, separating widely and helplessly the eastern and western settled regions and making increasingly hopeless the effort to build up there a homogeneous independent community.

The line follows closely the northern shore of Lake Superior for nearly 200 miles, most of it on the immediate shore of the lake, which is largely a rocky bluff, necessitating a great amount of very heavy rock work and trestling, and considerable loss of distance, but affording a constant succession of beautiful views hardly surpassed in the world. Port Arthur is already a thriving little town of 3,000 to 4,000 inhabitants, and has great hopes of yet becoming, as perhaps it may, a very important shipping point for the whole fertile district west and north of Winnipeg. The famous Silver Islet, and a number of other rich mineral deposits are close to it, but are not now being worked. In its immediate surroundings, however, or on the whole 430 miles between it and Winnipeg, there is little to support a town. An exception should be made of Rat Portage, however, where a wonderful and almost limitless water power exists, much greater than that at St. Paul and Minneapolis and ready for immediate use without construction of dams or canals, but as yet almost wholly wasted. The grain of the world, almost, could be ground here, not to say of Manitoba, *if* it could only be persuaded to come there or stop there but as yet, it declines to do so.

A Fast Run on the Chicago, Burlington & Quincy.

In view of the fact that considerable has been said, particularly by the New England Railway Club, about the time made by some of the fast trains of Eastern lines, it may be interesting to know one proof of what can be and is done by our Western roads.

Nov. 30, according to details for which we are indebted to a high official of the Chicago, Burlington & Quincy R. R., the fast mail on the Burlington, leaving Chicago at 3 A. M., arrived at Galva 55 minutes late, on account of one of the engine truck bearings running hot. It could not be cooled, and finally at Galva the engine was cut off and a freight engine (No. 339, Class A, 17 x 24) built by the Baldwin Locomotive Works, September, 1878), and freight engineer took the train, bringing it to Galesburg [23½ miles] in 29 minutes.

At 8:05 A. M (48 mins. late) engine No. 183 (standard Class A engine, 18×24) left Galesburg with the delayed train, composed of three six-wheeled mail cars, 60 ft. long, of 18 tons capacity each and fully loaded. The train arrived at Burlington (43.3 miles distant) at 8:59 A. M. making the run, including stops, in 50 minutes, or at a rate of 49 miles per hour. The train left Burlington at 9:05 A.M.(30 mins. late) arriving at Ottumwa on time, at 10:40 A. M., making the run from Burlington (75.2 miles distant) in 1 h. 35 m., including all stops, or an average of 47½ miles per hour. The train struck its time at Batavia, 13 miles east of Ottumwa Station, so that had it been required, from Batavia some five or six minutes more could easily have been added to the record. It will be seen, therefore, that the run as it stands, from Galesburg to Ottumwa (118.5 miles) including all stops, was made in 2 h. 35 m., an average of 45¾ miles per hour. Deduct from the run the time that the following stops would represent:

	Min.
1st.—Central Ia. R. R. Crossing at Monmouth, full stop, estimated	1
2d.—Monmouth Station, regular stop, transferring mail, full stop, estimated	4
3d.—Carthage Junction, slow up, estimated	1
4th.—Burlington Draw Bridge, full stop, estimated	1
5th.—Burlington Depot, regular stop, full stop, actual	7
6th.—New London, for water, full stop, estimated	4
7th.—Mount Pleasant, regular stop, full stop, estimated	3
8th.—Fairfield, regular stop, full stop, estimated	3
9th.—C. R. I. & P. R. R. Crossing between E. and W. Ottumwa, full stop, estimated	1
Total	25

The average speed between Galesburg and Burlington is 43.3 miles in 46 minutes, or 56.48 miles per hour; between Burlington and Ottumwa 75.2 miles in 77 minutes, or 59 miles per hour. The whole distance between Galesburg and Ottumwa, 118.5 miles, was made, exclusive of stops, in 123 minutes, or 57.8 miles per hour. The time lost in slowing up and starting at stopping places not being taken into account, the actual running speed must frequently have been up to 70 miles per hour for short stretches.

Taking all things into consideration, this is a remarkable record, which has never been much exceeded anywhere, and perhaps never equalled under comparable conditions.

AN UNUSUALLY HEAVY BRIDGE has been designed by Prof. P. C. RICKETTS, of the Rensselaer Polytechnic Institute, to cross the Erie Canal at Watervliet Arsenal, at West Troy. It will be used in transferring heavy guns from the machine shops to the wharf on the Hudson river. The bridge will be a riveted lattice, through structure, 100 ft. long, 14 ft. wide in the clear and will weigh about 148,000 lbs. The gun-truck and gun to pass over this bridge will weigh 448,000 lbs. which load is carried on two trucks with six pairs of wheels under each, on a base of 21 ft.

CORRESPONDENCE.

A Correction.

In the article on Silicated Iron and Steel, in our issue of Dec. 1, p. 427, 23rd. line from bottom, "the maximum strength of the silicated iron" should read 31.570 lbs. per sq. in., and not 23,570 lbs. as printed. This correction is a very important one in a comparison with the non-silicated iron, which has a maximum of 24,530 lbs.

Merits of Salt-Glazed and Cement Sewer Pipe.

ALBANY, N. Y., Nov. 23, 1888.

EDITOR ENGINEERING NEWS:

In response to the request from Helena, Mont., for information as to the relative merits of salt glazed and cement sewer pipe, I think I am safe in stating that the first sewers which were brought into use in this country for public service were constructed in this city, which has celebrated its bi-centennial existence. Since this time, sewers have been constructed of the various kinds of material, brick, stone, cement, glazed and unglazed pipe, commencing with brick of one square foot in size, and advancing to 6 ft. in diameter, and to storm water sewers with a sectional area of 85.9 sq. ft. with brick arch and stone inverts, equal to a circular sewer 9.87 ft. in diameter.

It was in this city also, that the first cement sewer pipe was made and brought into use. The first in semi-circular sections, followed by the Knight patents which were of the present style of bell and socket joint.

As to the relative merits of the materials for construction; for all sizes—under 2 ft. in diameter, the first quality of vitrified glazed pipe have proved to be the best. For all requirements above 2 ft. diameter, hard burned brick or durable stone laid in the best quality of hydraulic cement, are the only materials to be used—except iron, in special cases to overcome pressure on other requirements.

Cement pipe are not considered safe on account of the acids and alkalies which find their way into the sewers.

For making joints, Portland cement is preferable; but the Akron or other Western brands of cement are all that is required, when held to the usual engineering tests.

I may add that there is no problem in engineering more difficult to solve than a proper sewerage system, involving as it does the health and prosperity of a community, as well as the expenditure of so large a sum of money.

The city of Helena, notwithstanding its healthy location, is not an exception. In addition to the usual complications, embracing the size, and kind of pipe to be used, being an inland city without the advantage of a running stream of water, the requirements for flushing the pipes and the final disposal of sewage matter will be found to be a serious question which should be carefully considered before the final adoption of any system of works is decided upon.

PETER HOGAN.

A Pin-Connected Bridge which Did not Fail.

LOGAN, O., Dec. 3, 1888.

EDITOR ENGINEERING NEWS:

Apropos of your discussion on Mr. THOMPSON'S paper, on "American Bridge Failures", the non-failure of an "American Pin-Connected Bridge" which came to my notice during the time of my being engineer of bridges on the Columbus, Hocking Valley & Toledo Railway, may be of interest.

The bridge was a double intersection one of twelve panels, span about 170 ft., depth 30 ft., and was of single track.

The posts of the bridge were of Keystone section set on gib blocks, while the top chord and batters were formed of three channels and a plate.

A derailed engine ran off the ties at the first post, knocking it off the gib block, while the pilot bent the second so badly that it was of no service, almost pushing it out. The engine fell over so hard as to break one of the second set of diagonals, of which there were two. The remainder of the ties held it from going into the river, but were bent very badly, while the top chord sagged badly for three panels length.

While the end post was not thrown out, as in the case of the riveted bridge cited by Mr. THOMPSON, the bridge was very badly bent and broken up; it certainly speaks volumes for *good* pin connected bridges.

I have no doubt many other cases very similar could be found and think it would be no exaggeration to say that for every riveted bridge, might be found a pin-connected one that has stood up under as severe tests.

Mr. THOMPSON'S paper has had one salutary effect,—the members have had a chance to learn, that while "one ton was considered good practice when they were young, one and one-half to two tons are now used!"

I saw in print some time since that when ROBERT STEVENSON stood with ROEBLING viewing the erection of the Niagara Suspension bridge, he said, "If yours is a success, mine is a huge moustrosity," referring to the Victoria bridge. Without by any means reflecting on his genius and consummate ability, I have wondered what he would have said could he have seen the Lachine bridge, the work of an American, C. SHALER SMITH. Let them first see the great advantage of pin connections, some of the large bridges of this type, and then—"when he knows 'em, then he goes and does 'em."

Very truly yours,

C. E. FOWLER,
Bridge Engr., Motherwell Iron & Steel Co.

Wellington's Manual of Railroad Field Work.

Office of Chief Engineer' Schuylkill & Lehigh Valley R. R. Co.

SCHUYLKILL HAVEN, Pa., Dec., 10, 1888.

EDITOR ENGINEERING NEWS:

Will you please inform me whether your "field book" or "hand book for engineers" is published and on the market. If it is ready, please state the price and where it can be obtained.

Yours truly, R. A. WILDER.

In answer to this and many other like inquiries, we will state that the MS. of the work is now in an advanced state of preparation, so much so that it appears quite certain to be published complete some time in 1889. The book will be of pocket-book size; same page and general form as Henck, Searles and Shunk, and will be published at $4.00; being a thinner volume than Searles, but somewhat thicker than Shunk and Henck.

So many of the formulæ and demonstrations are entirely novel, and the form of the rest is so largely new, that we have decided by arrangement with Mr. WELLINGTON to run the great bulk of the book through ENGINEERING NEWS serially. Owing to the special interest which has been shown in Mr. WELLINGTON'S method of transition curves, which nowhere exists in print as yet, although extensively in use in MS., and which greatly simplifies field work by enabling the curves to be laid out either by offsets or deflection angles and using any offset with any curve, we shall begin shortly after Jan. 1, by the publication of the matter referring to this method out of its regular order, possibly following with the articles on frogs and switches and earthwork computation.—ED. ENG. NEWS.]

The Sewerage of New York.

Department of Public Works, Office of Engineer in Charge of Sewers, 31 Chambers St., Room 9.

NEW YORK, Dec. 11, 1888.

EDITOR ENGINEERING NEWS:

In your summary of my recent report to Gen. JOHN NEWTON, late Commissioner of Public Works, there are a few sentences which convey quite different impressions from those conveyed by the report, and I trust you will allow me the privilege of correcting them.

The statement that "many of the existing sewers are badly adapted to their purpose and very few are self cleansing", having rough interior surfaces, improper shape, etc., refers only, as the report says, to "the old sewers in the lower part of the city." Those constructed during the last 20 years are very well built, well shaped, and are nearly all self-cleansing. It is also stated that "more attention should be paid to the proper joining of sewers" etc., but the report adds: "The newer sewers, as a rule, are satisfactory in this respect."

The summary further says: "The results show that while these rules (old rules for proportioning sizes) will apply to flat unbroken areas and light rainfall, they are not applicable to the densely built-up area and heavy rainstorms of New York." As it does not say *what* results, it might be well to add that continuous gaugings have been made for nearly one year both of the rainfall and flow in a large sewer, and that it was the result only of these recent gaugings, the first of the kind that have been made in this city, which led to and justified the above conclusion, indicating that a much larger proportion of the rainfall actually enters the sewers in New York, than that which is assumed by the older formulæ and rules.

RUDOLPH HERING.

[We owe an apology, and heartily make it, to the engineers who have had charge of the sewers of New York in late years. The report mentioned came to hand late, and as space forbade its reproduction in full, the "blue-pencil" was used to an extent that unintentionally did an injustice to the engineering staff in charge by omitting important saving clauses. We trust the letter of Mr. HERING will make the correction due.—ED. ENG. NEWS.]

Clamp for Brace-Rods of Bridges.

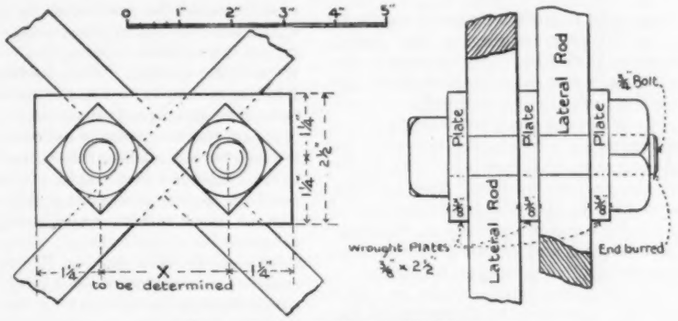
CINCINNATI, Nov. 19, 1888.

EDITOR ENGINEERING NEWS:

I send you a copy of a little detail that may be of interest to some of your readers.

It has been found necessary to adopt some means to prevent the lateral and brace rods of the iron bridges and viaducts on the Cincinnati, New Orleans & Texas Pacific R. R. from wearing into each other where they touch one another at their intersections.

Binding the rods together with wrappings of telegraph wire has been tried; but as these wrappings work loose and require frequent attention, this method has been condemned as ineffective by our Inspector of Bridges and Buildings, Mr. M. WALSH.



Clamp for Brace-Rods of Bridges.

The device here illustrated was designed by me to preserve the brace-rods from wearing into each other and also to keep the rods from rattling. It can be readily applied to either horizontal or vertical brace-rods; can be applied to rods intersecting at any angle by simply making *X* the proper length; and even if the bolts loosen, it is still effective in preventing the wear of the rods by distributing this wear over the line of contact of the rod and the plate interposed between the rods, thus increasing the wearing area in the case of round rods from a point to a line several inches long. This device has been applied to many of our old bridges with satisfactory results, and is now put on all of our new work.

Yours truly,
WARD BALDWIN, Asst. Engr.

Contour Protractor for Topography.

SEATTLE, W. T., Nov. 18, 1888.

EDITOR ENGINEERING NEWS:

Topography on railroad surveys is as yet mostly taken with the aid of a slope level, or clinometer, out here in this western part of the continent, and the method has certain advantages. Where the ground is covered with dense woods standing, and as much laying down, it is impossible to carry along a plane table and sheets on which to plat the topography in the field. Where logs from 3 to 10 ft. in diameter, charred on the outside, and often piled on top of each other have to be climbed, and with thick brush to go through, the topographer has all he can do to carry his note book and clinometer with him. Besides this hindrance, there is a good deal of rain on the Pacific slope; which makes it extremely difficult to keep his sheets dry. When the notes have been taken with a clinometer, it is always an annoyance to the draughtsman to calculate his distances out to the contours. This work is slow, tedious and liable to errors. To plat the slope on cross section paper is also a slow method. The idea occurred to me that an instrument convenient for establishing contour distances graphically could be constructed, and I herewith send sketch of same and show how it is to be used.

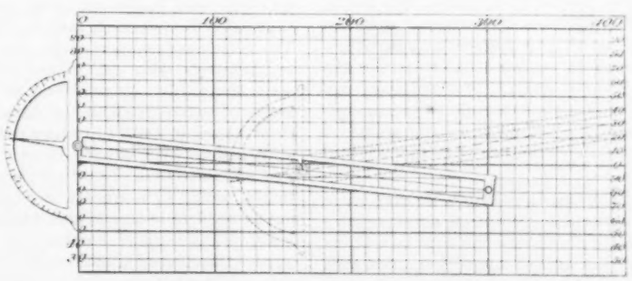
The instrument consists of a semi-circular protractor graduated from zero on the middle of the arc 90° each way.

In the center around a hollow axle swings a bar with a slot in one end extending to the protractor and an indicator on the other end. In the center of this slot is stretched a fine steel wire. The projection of this wire would go through the center of the protractor and the point of the indicator when the instrument is in adjustment.

The opening in the pivot is filled with a transparent substance on which the center of the protractor is marked.

In using the instrument, a small board is provided for, about 12×20 ins. and ¼ in. thick. On this board is stretched cross section paper or profile paper; Plate *A*, is best; giving a convenient scale of ¼ in. 10 ft. This paper is varnished, as no lines need be drawn. The board with the paper is furnished by instrument maker. On one of the heavy vertical lines on the left side of the board are marked the elevations from 0 to 100 representing the elevations of the stations on center line. On the upper edge of the board horizontally are marked distances out, 100, 200, 300 ft. etc.

If, for instance, the elevation of a certain station from which slopes are taken is 312 ft., the center of protractor is placed over this point with edge over vertical line, as on sketch, and the bar moved till the indicator reads the slope angle. Then where the thin wire crosses the first horizontal line is the distance out to the first contour. On sketch, contour 310 is 20 ft. out; contour 300 is 11.7 ft. out, etc. When a break in the slope occurs, as for instance 165 ft. from center the instrument is moved to that point, new slope angle read off, and new distances out read on horizontal lines. The whole thing is laid in front of the draughtsman like a book, and he can read off his distances as fast as he can scale them on the map.



Contour Protractor for Plotting Topography.

The instrument can be used as an ordinary protractor with vernier attached if desirable. Two sets of graduations are used, one in degrees and the other in rise and fall in 100 ft. I have one in use and it gives excellent results,

Yours truly,
M. STIXRUD, Asst. Engr. S., L. S. & E. Ry.

[We give place to this communication, simply to express our regret that the making of topographical maps should be impeded and made costly (not to say likewise inaccurate) by the use of such unnecessarily cumbrous methods. Let our correspondent remember that the horizontal distance apart *D* of contours having a vertical equidistance *h* on any given surface slope *S* is given by the simple formula:

$$D = h \cot S$$

Assuming his contours to be 10 ft. apart, with a 400 ft. per inch scale, let him then take a single strip of Bristol board, which has 2 × 2 = 4 edges, and plot for each successive surface slope, beginning with 1°, the proper distance apart for 3 or 4 contours of each slope, as given in the following table, computed under the above formula by the simple process of reading off the natural cotangent of each surface slope, and moving the decimal point one place to the left.

Slope	Dist.	Slope	Dist.	Slope	Dist.	Slope	Dist.
1°	572.9	6°	95.1	12°	47.0	25°	21.4
2°	286.4	7°	81.4	14°	40.1	30°	17.3
3°	190.8	8°	71.2	16°	34.9	35°	14.3
4°	143.0	9°	63.1	18°	30.8	40°	11.9
5°	114.3	10°	56.7	20°	27.5	45°	10.0

The distances between contours for the flatter slopes being so considerable, he will probably not need more than one or two spaces for them; and he may, if he please, divide the long spaces for 1° to 5° slopes into halves, quarters or tenths by light marks, so as to give exactly the distance out to a contour for a rise of 5, 2½ or 1 ft. from any point.

If, now, with his given center line elevation of 312, and his given surface slope (which he does not specify, but which is 5° 53′ exactly, and which was probably plotted with the idea of making it 6°, as it would be tolerably sure to be in the notes) he cannot take take the 6° part of his scale, estimate by eye $\frac{3}{10}$ of one of his spaces for the distance out to contour 310, and then simply mark off equidistant spaces from his scale for contour 300, 290, etc., for as far out as his slope extends, and then change to another slope; and if he cannot do the whole of this, and sketch his contours through the points, while he is simply setting his contour protractor, he is not very alert. And if he cannot lay off like spaces for 6° and 7° successively and split the difference between them if his slope happens to be 6° 30′ or 6° 40′; or if he cannot estimate the fractional excess of a contour space to where one slope ends, and begin thence in the same way with a new slope, he is not very ingenious.

We may add that the scale thus constructed for 10 ft. contours and a 400 ft. scale, will answer equally well for 5 ft. contours and a 200 ft. scale, or for 1 ft. contours and an 80 ft. scale and that most railroad work would be much better done than it is if larger scales were used, while the drafting work is not appreciably increased, if done, as it always should be done, on loose sheets matched together at random and properly marked so that they can be exactly replaced. ED. ENG. NEWS.]

e Driving with Gun-Powder.

GREYTOWN, Nicaragua, Nov. 19, 1888.

EDITOR ENGINEERING NEWS:

Can you inform me where I can find out about pile drivers working by concussion, using gun-powder. Name of manufacturers, prices, and other details? If so you will greatly oblige an old subscriber.

Yours very truly,
J. FRANCIS LE BARON.
1st. Asst. Engineer in Charge. N. C. C. Co.

[A full description of this ingenious device will be found in ENGINEERING NEWS of June 24, 1876, and also, with somewhat fuller details, in *Engineering* May 19, 1876. Fuller information, giving the entire history and working of the device to date can probably be obtained from the designer of the original plant, Mr. F. C PRINDLE, C. E., Gen. Man. Carolina Oil & Creosote Co., Wilmington, N. C. ED. ENG. NEWS.]

ENGINEERING NEWS

AND AMERICAN RAILWAY JOURNAL

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Coming Technical Meetings.

Engineers' Society of Western Pennsylvania, Ittsburg, Pa.—Regular meeting, Dec. 18. Secy., S. M. Wickersham.

Boston Society of Civil Engineers, Boston, Mass.—Regular meeting, Dec. 19. "Efficiency and Economy of the Graphic Method in Surveying," by Wilard D Johnson; "Stadia Work," by J. R. Freeman. Secy., S. E. Tinkham, City Hall.

Engineers' Club of St. Louis, Mo.—Regular meeting Dec. 19. "Changing the Gauge of the Ohio & Mississippi Ry.", I. A. Smith. Secy., Wm. H. Bryan. 709 Market St.

American Society of Civil Engineers, New York.—Regular meeting, Dec. 19. Secy., John Bogart, 127 E. 23d St.

New York Railway —Next meeting Dec. 20. Rooms 113 Liberty St., New York City.

Engineers' Club, Philadelphia, Pa.—Regular meeting, Jan. 5. Secy. Howard Murphy, 1122 Girard St.

Civil Engineers' Society of St. Paul, Minn.—Regular meeting, Jan. 7. Secy., Geo. L. Wilson, City Hall.

Engineers' Club of Kansas City, Mo.—Regular meeting, Jan. 7. Secy., Kenneth Allen, Y.M.C.A. Building.

Civil Engineers' Club of Cleveland, O.—Regular meeting, Jan. 3. "Report on Architecture." Secy., James Ritchie, Case Library Rooms.

THE last London accounts concerning the Panama Canal announce the acknowledged failure of the late loan. Only 180,000 bonds were subscribed for, and under the conditions of the original call the money paid in for these must now be returned to the subscribers. CHARLES DE LESSEPS is quoted as stating that this result means "bankruptcy or the winding up of the affairs of the company"; just where the difference comes in, as far as the legion of original shareholders is concerned, does not appear. Owing to the somewhat mixed accounts in the press we must defer further discussion until next issue. The collapse appears to be complete; though desperate efforts will doubtless be made to reorganize on some basis of little or no benefit to the original shareholders.

THE Sarnia tunnel, as to which we give quite full details in another column, is an especially interesting work as almost the first one of its type in the world, and as one which, once successfully completed, is likely to be duplicated with increasing frequency. For one thing, it would be a very safe wager that there would be at least two other tunnels under the St. Clair or Detroit rivers in a very short time after the first one was opened for traffic. The nearest existing approach to the Sarnia tunnel (if it can be said yet to exist) is the half finished Hudson River tunnel at New York; but this is lined with brick inside the iron plates, and hence the latter are much thinner than at Sarnia.

We see no reason why the Sarnia tunnel should not be an entire success, although we anticipate that there will be some trouble with the pilot shield, which seems hardly strong and rigid enough, and we suspect will have to be much strengthened or replaced by one of more adequate design. This, however, is a mere detail, as to which we may be wrong, and which is not likely to cause worse than delay in any case. That the river can be successfully tunneled on substantially the plan proposed hardly admits of doubt; and we think it is fortunate that the effort to eliminate the river as an obstacle to railway transportation has at last taken this form; because the commerce of the river is so enormous and so rapidly increasing that no kind of a bridge should be permitted until the impracticability of a tunnel at reasonable cost is entirely clear. The abortive attempt at a Detroit tunnel some 16 years ago, abandoned after the headings had been driven some 1,300 ft. under the river, was in no sense a real failure, since it is now generally admitted that the difficulties encountered were far from insurmountable.

WE learn that it is under consideration by some of the Western members of the American Society of Civil Engineers to make a motion ere long for a complete revision and recodification of the Constitution of that Society, to correct the many evident defects of that instrument and obviate the necessity for perpetual attempts to tinker it in detail, which are otherwise sure to continue. The immediate cause which is provoking this movement is the necessity for some change in the manner of nominating and electing officers, and in the membership of the governing body.

We hope this motion will be made, and that it will prevail. The present Constitution has many crudities and anomalies from which the Society is grievously suffering, and which ought not to be permitted to longer continue. To speak only of a few: The present method of nominating and electing officers is a travesty of a real election, shutting off all opportunity for a real choice by the members, and so tending to deaden the interest of the great body of the membership in an adminstration over which they have no practical control. A "nominating committee" is chosen *viva voce* almost by hap-hazard at the convention, who are deliberately scattered over the continent with the supposed end of representing the whole Society. As a natural consequence they never meet (last year, we believe, was the sole exception); they consult no one unless possibly a few friends; they nominate practically on their own judgment alone, and they nominate only just enough men to fill the offices. The nominations once made, they are sent out to members, who can either vote the list as sent them, like automatons, or "scratch" a name or two without the slightest chance that their "scratch" will have any practical effect, or combine with others in the disagreeable and offensive task of getting up an opposition ticket, which it is wholly useless to do without considerable electioneering and overt criticism of the regular nomination. As a consequence the elected men are in every case merely "the accident of an accident", the nominating committee. They are in no sense an expression of the Society's choice. The proper remedy is to have at least two nominations for each office on the same ticket, and require one name to be erased to have the ballot counted, as is done in most other societies; or a less desirable remedy, but still much better than the present plan, would be to have two tickets regularly and independently nominated.

OTHER matters in which a change in the Am. Soc. C. E. Constitution is very desirable are: The governing body is too small; less than half the size of other analogous bodies; and not large enough to be truly representative of the whole Society. It should hold a less number of meetings of the full Board, not more than two to four a year, in order that the attendance may be larger at meetings which fix the general policy of the Society; delegating much of the routine work to some executive committee which holds more frequent meetings, but does not control the Society's policy. The Secretary and Treasurer should not be members of the Board by which their actions are controlled, nor should they be elected by the Society, but by the Board whose officers they are. The salaried Secretary should no longer be himself an engineer in active practice; but should give his entire time and energy and thoughts to the administration of the Society's affairs and the advancement of its interests. The Society has now become so large as to imperatively demand this, and its business cannot be properly carried on otherwise; while the salary paid, $3,000 and house-rent, equivalent to considerably over $4,000 cash, should be sufficient to command the entire time of a first-class man, especially as it may reasonably be expected to be advanced from time to time. The Institution of Civil Engineers has both an unsalaried Honorary Secretary and a paid administrative Secretary, Mr. JAS. FORREST, who is universally admitted to have been a leading factor in that organization's vigorous and rapid growth. Had he been in active professional practice in addition, as good results could hardly have been obtained for many reasons. The present Secretary of the Am. Soc. C. E., we fear, is too eminent an engineer to afford to give his whole time to the Society for the salary paid, which is in every way unfortunate, for there is probably no man in the whole Society who is so eminently qualified to fulfill all the requirements of the office. If he could be induced to accept the office permanently under the specified conditions, no better Secretary could be desired, and certainly not hoped for, but in our opinion the Society has now grown to the point where its welfare imperatively demands that the salaried Secretary should give his whole time to that office.

Various other matters as to which reorganization is desirable invite discussion, but we cannot now attempt to consider them. We hope they may all be considered ere long, through an appropriate Committee on Revision of the Constitution.

THE House spent several hours last week in considering the bill to incorporate the Maritime Canal Company of Nicaragua, and the outcome was a partially successful attempt of its enemies to load down the bill with amendments that would virtually kill it. These amendments provided that the Government must in no way assume any liability or responsibility and that this proviso must be printed on each Canal bond; that the Government should have the power to regulate tolls, and that the construction must be commenced in three years and that the issue of stocks and bonds is to be limited, etc.

This well-planned obstruction by the friends of the Panama scheme and of another defunct project dating back to 1849, would be as absurd as it is vicious were it not really blocking the way for the enactment of a measure of national interest and importance. The Maritime Canal Co. before going to Congress had expended hundreds of thousands in first assuring itself that the enterprise was feasible and that its cost would not be out of proportion to the end in view. The value of this canal to the commercial world in general and to the United States in particular is undoubted; the only question was—can it be built within practicable limits, and how much will it cost. This question has been fully answered at private cost, and to raise the enormous sum required for the speedy and economical completion of this huge enterprise the Company now only asks a national charter that will stamp it as an American enterprise. It does not ask a penny of Government money or a Government guarantee of its stocks or bonds. As the Government will not undertake the building of the canal, and is yet very

unwilling that its construction should pass under foreign control, it would seem that the least it could do was to recognize, and if necessary protect, such of its citizens who stood ready to invest private capital in an enterprise of such exceedingly great national importance.

The most absurd and impudent of all the amendments tacked on the bill is that one assuming to regulate tolls and the general management of this canal running through a foreign country, and in the same bill to specifically disclaim any liability or responsibility for this work in which the Government is not to invest a dollar under any circumstances. In the haste to load the bill with amendments intended to kill it altogether, the lobby forget to be even consistent in its enmity. As this bill is to come up again soon, it is to be hoped that a little more common sense and an honest regard for the interests of our whole country will characterize its further discussion. It is too serious a matter to be longer left in the hands of Congressional touters for individual interests.

THE official ballot list of officers for the Canadian Society of Civil Engineers, for 1889, is published in another column, but we are informed that an anonymous opposition ballot has likewise been sent out, on which the name of MR. ALAN MACDOUGALL has been placed for one of the vice-presidents. We are not advised as to the motives underlying this opposition nomination, but we have the best of authority for stating that MR. MACDOUGALL is entirely in accord with the official list, and requests the members not to vote for him. We certainly hope that nothing will be done to destroy the good feeling now existing among the members of the Society, and ordinarily (unless there are known special reasons to the contrary of which we are not advised), a request of this kind should be regarded as binding on, and be respected by every voter.

Nova Scotia Coal Mining.

An interesting and elaborate paper on "Coal Mining in Nova Scotia", by E. GILPIN, Jr., reaches us by advance sheets from the Canadian Society of Civil Engineers, being another of many evidences of the vigorous and healthy growth of that organization. It is already, although only two years old, a vastly more energetic and successful organization than the American Society of Civil Engineers in proportion to its field, whether the standard be the proportion of competent engineers included in its membership, or the amount of valuable technical matter which it succeeds in bringing out and preserving in its Transactions.

The paper referred to is an especially valuable and complete one, which every one interested in coal mining will do well to secure a copy of, through the Secretary, Prof. BOVEY, of McGill College, Montreal. We cannot attempt, nor are we at liberty, to make any full summary of its contents, but we notice one absurd statement which should not go uncontradicted, in the interest of proper commercial, or it may yet be, political relations between Canada and the United States.

It appears that the output of coal mines in Nova Scotia, for the American and Canadian market, has been about as follows, under varying United States duties:

	U. S. duty.	U. S. market. tons	Total product, tons
1850-53	24% ad.	120,000	150,000
1854-66	Free	incr. from 139,000 to 450,000	160,000 to 520,000
1867-71	$1.25	decr. from 450,000 to 165,000	520,000 to 785,000
1872-87	$0.75	decr. from 165,000 to 73,892	785,000 to 1,519,684

In regard to these figures it is remarked:

"These figures show the steady growth of the home markets, and the fact that there is at present little room for Nova Scotia coal in the New England markets. The mutual removal of the duties on soft coal would, in the opinion of many of the provincial coal mine managers, result in the almost total loss of the Upper St. Lawrence trade, without any prospect of replacing it by a trade with the Eastern seaboard of the United States, which would have to start with a basis of at least 750,000 tons."

No more absurd statement could well be made. It ignores the enormous growth in coal consumption since 1866, the last year in which Nova Scotia coal competed for the American market on equal terms, although one would think that the fact that since that date the Canadian consumption has increased from about 70,000 tons to 1,446,000 tons might have suggested that the American market had expanded in about equal ratio, although the heavy loading of 75 cts. per ton shuts out the Canadian mines from all share in this growth. As a matter of fact, the total coal consumption of the United States has increased from about 21,000,000 tons in 1866 to over 120,000,000 tons in 1888, so that a trade of 450,000 tons in 1866 should represent nearly 3,000,000 tons in 1888; and it cannot be reasonably doubted that had the Canadian mines been situated on the coast of Maine, as they are on the coast of Nova Scotia, they would to day have an American trade of fully 5,000,000 tons, with a large part of the Canadian trade in addition, over half the output being confined to the seaboard provinces. We may admire and respect the loyalty of the Canadians to what is called their "mother country" (although it is the "mother country" of a less proportion of them than it is of the United States) but no good end is served by concealing the fact that this loyalty is displayed at a fearful pecuniary sacrifice in almost every Canadian interest, and in none more conspicuously than in coal mining; although the Nova Scotians are so completely "out of the swim" of continental progress that they may hardly realize this fact.

IT will perhaps be of interest for us to reproduce some of the startling figures of the growth of the coal mining industry of the world. In *millions* of tons the output of the past 45 years has increased as follows:

	1842	1860	1880	1884	1886	1887
Gt. Britain	35	85	147	160.8	157.5	—
U. S.	3	15	70	99.4	106.5	120.2
Central Europe	19	36	118	125.4	137.0	—
Other countries	4	5	9	8.4	8.5	—
Total	61	141	344	394.0	409.5	—
Percentages of average ANNUAL *increase.*						
Gt. Britain	—	5.05	2.78	2.27	(—1.03)	—
U. S.	—	9.35	8.00	9.16	3.51 (av. 6.54)	12.9
Continent	—	3.61	6.12	1.55	4.52	
Other co'ntries	—	2.19	2.98	(—1.74)	0.06	—
Av. of the world		4.28	5.08	3.45	1.95	

The percentages have been computed logarithmically and show the true equivalent ratio of annual growth between the periods given. It will be at once seen how rapidly the United States is overhauling all other countries, and how vast beyond comprehension has been the growth of the coal consumption of the world since 1860, which we are in the habit of looking back upon as a rather advanced and civilized era. England then produced over 60 per cent. of the world's coal supply; it now produces only 38 per cent., and but little more than the Continent, which has been distinctly forging ahead, doubtless as an effect of the protection policy. The "other countries" are chiefly the British Colonies, and show the poorest growth of all, although the aggregates are so insignificant that a number of the colonies, separately considered, would show larger *ratios* of growth than any of the above; but in dealing with small quantities ratios are highly deceptive.

To show the market which is open to the Canadian mines, it is only necessary to say that the yearly consumption of New York *City* only is:

	Tons.	
Anthracite	3,700,000	
Bituminous	1,500,000	
Gas and cannel	300,000	5,500,000
Brooklyn, anthracite	1,500,000	
" bituminous	400,000	1,900,000
Jersey City and Staten Island		725,000
Boston, anthracite	1,100,000	
" bituminous	1,300,000	2,400,000
Baltimore, about		2,000,000
Etc. etc., against		
Montreal, anthracite	215,634	
" bituminous, Gt. Britain	44,326	
" " Nova Scotia	343,496	603,456

In the face of such figures it sounds rather silly for the "provincial coal mine managers" to wonder if they could really find a larger market for their coal if they had the chance. The Blue-noses should at least wake up to facts.

The Water-Works of the Middle States.

The compilation of our forthcoming "Water-Works Manual", the completeness of which may be judged in some measure from the accompanying tables, has progressed so far that we are now able to summarize the status of the water-works of the Middle and Southern States. We confine ourselves in this issue to the Middle States.

For convenience of comparison with our review of the New England Water-Works (Oct. 13 and 20) we give our tables the same numbers as the corresponding ones for the New England States, distinguishing them only by adding the letter *B*.

The water-works of the Middle States are an immense interest, larger even than those of the New England States, and much larger than those of any other group of States. In the aggregate $156,522,264 are invested in 433 works, against $84,992,725 in 287 works in New England.

As in New England, the great majority of the water-works are of very recent construction. Table 1-B shows that there were constructed:

		Middle States.	N. Eng
Before 1850, a total of		30	12
Decade ending	1860	34	16
" "	1870	33	32
" "	1880	118	76
7½ years "	1888	218	150
A total of		433	286

Thus a fraction over one-half of the water-works of the Middle States, as of New England, have been built in the last 7½ years, and 26 per cent. of them have been built within the last 2½ years, against 27 per cent. in New England, a singular constancy of ratio. Before 1850, however, the Middle States led considerably.

The capital invested in water-works as compared with railways bears a much less ratio than in New England, because the railway valuations of the Middle States are so enormous, being paid tribute to by the entire country. The nominal value (stocks and bonds) of the Middle States railways is $2,154,279,370 or in the ratio of 13.75 to 1 against only 4.12 to 1 in New England. Reducing this to a cash valuation, however, the real ratio will hardly be more than 6 or 7 to 1 in the Middle States against 2½ or 3 to 1 in New England.

In miles of water mains and railways the comparison stands as follows:

	Miles of Water mains	Railways
New York	3,227	7,552
New Jersey	1,013	907
Pennsylvania	2,471	7,590
Delaware	85	254
Maryland	612	1,350
Total	7,428	18,662

There are 2.51 times as many miles of railway as of water mains in the Middle States, against only 1.26 times in New England. Few

would imagine that the aggregates were so nearly equal in either section.

It is to be borne in mind in examining Tables 3 and 5, that as we stated in reviewing the New England water-works, it is impossible for us this year to show the actual status of water-works at the end of each decennial period. The most we can do in this issue is to show the *present* status of the works *first opened* in each decade. Thus all the increase in the earlier works, which is usually far greater than the whole original investment and plant, is credited to the decade when the works were first opened.

The population statistics given in Table 6-B are perhaps the most interesting of all. They show that 52.5 per cent. of the total population against 59.8 in New England are on water-works. The total census town population (in towns of 4,000 or over) is 47.2 per cent. instead of 49.6 per cent., and the percentage of this *town* population supplied is 113.1 against 120.6 per cent., indicating that in the Middle as in the New England States, more than the total population in towns of 4,000 or over is supplied, as we shall probably find to be the case throughout the United States. The increase of total population has been slightly greater than in New England, 19.4 against 15 per cent., accounting in part for the late more rapid progress of water-works.

The percentage of water-works in towns of various sizes is:

	Towns of				
	Under 1,000	1,000 to 3,000	3,000 to 5,000	5,000 or over	Total
Middle States	10.9	40.2	18.0	30.9	100.0
New England	13.9	27.8	22.6	35.7	100.0

Thus a larger proportion of the Middle States water-works are in towns of under 5,000 than in New England; and this is the fairest test of comparative enterprise and progress.

Table 8-B gives some very interesting financial statistics, from which it will appear that the investment per head and per tap (of population on water-works) is considerably smaller than in New England, but the cost per mile of main large. The revenue per head is singularly constant at about $2.50 per tap, a little less because of a fractionally smaller population per tap (6.9 instead of 7.6); and per main, much larger, owing to a larger number of taps per mile of main. The average gross earnings of water-works are 9.4 per cent., against 7.54 in New England. New Jersey, Pennsylvania, and Delaware show the large rate of 12 per cent., being much higher than any New England State.

Table 9-B shows that the proportion of gravity works is somewhat less than in New England, 42.4 against 50.4 per cent. Direct pumping works are nearly 4 times as numerous but still not common, being only 40 (chiefly in New York) out of 233. Stand-pipes and tanks are rather less common than in New England. It is a singular fact that the percentage of gravity works is larger in New York than in Pennsylvania, a much more hilly State. Evidently New York has been willing to spend more money on its works, for it is a singular fact that, although Pennsylvania has 7 more works, (173 against 166) the New York investment in water-works is more than double; $80,944,713 against $38,525,581, and the miles of mains also a third larger.

In classifying the pumping works, only those have been regarded as pumping "direct" which pump their ordinary supply thus. Many if not most of the pumping works have arrangements to pump direct in case of fire, as is shown in part in Table 12-B.

SOURCES OF SUPPLY.

Table 10-B, giving sources of supply, shows some interesting contrasts with the New England States, especially in the number of works supplied from lakes and ponds. In Pennsylvania and Maryland there is not a single works supplied from lakes, except 2 which draw from Lake Erie, the reason being that there are no lakes to draw from. In New York there are only 15 against 70 in New England. Lakes are a phenomenon due to incomplete erosion or to gravelly deposits due to ice action, and occur in large numbers only in northern latitudes. In British America, as we have noted in another article in this issue, there are tens of thousands; in northern New England, Michigan, Wisconsin and Minnesota there are likewise thousands, but very few elsewhere on this continent. Wells are much more largely used in the Middle States than in New England, and surface supply less. Rivers and creeks supply 36 per cent. of the works against 14 per cent. in New England.

WORKING PRESSURES.

Table 11-B shows that these average somewhat lower than in New England (68.3 against 72.5 lbs.) due chiefly to a low average of 47.4 lbs. in New Jersey. About 60 per cent. of the works range between 40 and 80 lbs., but there are many which range much higher, most of the larger works being lower. The fire pressures, given in Table 12-B, call for no special remark. There are 30 per cent. of the works in all which use higher pressures.

OWNERSHIP OF THE WORKS.

Table 13-B gives these statistics, showing that 4,829,527 out of 6,165,618 population on water-works in the Middle States are supplied by 137 public works, leaving only 1,336,091 to be supplied by the remaining 271 private works, an average of 4,930 per private work, against 3,980 in New England. In all, 78.3 per cent. of the Middle States water-works population are supplied by public works, against 72.3 in New England. Almost precisely the same per cent. of the census city (over 4,000) population (85.2 against 87.5 per cent.) are supplied by public works.

Maryland shows up very well, the best of all the 5 States, in the degree to which water-works have been carried into small towns, having a population of only 3,055 per private works, against about 4,600 in New York and Pennsylvania, and 3,470 in Massachusetts. Vermont's remarkable record of only 1,930 inhabitants per private work, however, is not approached in the Middle States.

USE OF METERS.

Table 14-B shows that the use of meters is far less common in the Middle than New England States, there being only 33,991 in all against 37,913. 18,000 of these are in New York alone, the number remaining being divided in small lots, for the most part, among a large number of works. Pennsylvania seems to have a surprisingly poor opinion of meters, or an extra abundant water supply, the number in use being only 912, 253 of them in Philadelphia.

HYDRANT RATES.

Table 15-B shows the hydrant rates so far as reported to the nearest $5. They will be seen to range somewhat higher than in New England, some ranging very high. In Pennsylvania there are many very low rates, doubtless, due to the abundance of supply and low average cost of the works. Many towns which do not pay a specific hydrant rental pay one in effect by specified large payments for all city water supply. These cases it is impossible to take account of.

PUMPS.

Table 16-B will perhaps be examined with more interest than any other, by a certain class of our readers at least. The Worthington maintains the large lead which it had in New England, but the Holly-Gaskill is a good second, and far ahead, relatively, of its New England showing. The "miscellaneous" includes a large amount of water-power pumping, including not less than 33,300,000 galls. daily in Philadelphia alone. The Philadelphia pumping plant, being the largest in the country, has a special interest. It consists of

	Galls. daily.
Water-power	33,300,000
10 Worthington pumps	77,000,000
1 Holly-Gaskill	20,000,000
2 Marine compound	30,000,000
1 Corliss	10,000,000
1 Simpson	8,000,000
1 Cornish	2,250,000
2 Davidson	2,000,000
3 Knowles	750,000
Total daily capacity	183,300,000

Of this aggregate only 88,850,000 galls. is now regularly used.

NEW CONSTRUCTION.

We have details of the following works as projected with fair prospects of early construction:

New York	8
New Jersey	2
Pennsylvania	6
Delaware	0
Maryland	3
Total Middle States	19
Against, reported for New England States,	25

This will be an addition of about 5 per cent. against 9 per cent. in New England, all of which are likely to be completed in 1889. Some may fall through, but others, not now reported, will more than make up for them.

TABLE 15-B

MIDDLE STATES WATER-WORKS.—HYDRANT RENTAL.

(Nearest even $5 taken.)

Hydrant rate.	N. Y.	N. J.	Pa.	Md.	Total.	Total N.E.
Free	.....	3	8	.....	11	14
$ 5	.....	1	6	1	8	1
10	.....	.....	8	2	10	6
15	2	2	10	2	16	11
20	2	.....	7	1	10	11
25	2	4	5	2	13	7
30	5	1	4	.....	10	17
35	5	1	3	.....	9	8
40	12	1	4	.....	17	13
45	5	2	1	.....	8	4
50	8	3	9	.....	20	16
55	1	.....	.....	.....	1	.....
60	4	1	.....	.....	5	1
75	1	.....	.....	.....	1	1
90	1	.....	.....	.....	1	.....
100	1	.....	.....	.....	1	.....
Total	49	19	65	8	141	110

The above includes all the works which report a hydrant rental seperately. Nearly all the private works receive an indirect rental of some stated sum including water supply of city buildings, etc.

PERSONAL.

ARTHUR CROOKS, architect, of New York, died in this city Dec. 8, at the age of 52.

ALBERT W. SMITH has been elected Commissioner of Public Works at Providence, R. I.

R. L. VAN SANT has been appointed Chief Engineer of the Indianapolis, Decatur & Western Railway, with headquarters at Indianapolis, Ind.

Col. R. R. BRIDGERS, who has for a number of years been President of the Wilmington & Weldon road, died suddenly this week at Columbia.

WILLIAM STEVENS, late Roadmaster of the Georgia Central, and who went to Mexico to accept a position on the Mexican National Railway, has returned to Macon, Ga., and will in future reside in Georgia.

JOHN S. WILSON, late General Traffic Agent of the Pennsylvania Railroad, has been elected President of the Poughkeepsie Bridge Co. He has also been elected President of the Hudson Connecting Railway Co., the Poughkeepsie & Connecticut Railway Co. and the Poughkeepsie Bridge Railway Co.

CHARLES E. EMERY, M. Am. Soc. C. E., at the last meeting of the Brooklyn Bridge Trustees, submitted a bill of $10,000 for services as consulting engineer in connection with plans rendered by him for improved terminal facilities. The bill has been referred to a special committee.

Tables Showing the Present Status of Water-Works of the Middle States.

TABLE 1—B.

MIDDLE STATES WATER-WORKS.—SUMMARY OF DATES OF CONSTRUCTION.

[Date of completion taken when construction extended over more than one year.]

YEAR.	Water-Works Built.			YEAR.	Water-Works Built.		
	Main.	Subsidiary.	Total.		Main.	Subs.	Tot
Before 1800	3	.....	3				
1800-10	6	.....	6	1871	16	.....	16
1811-20	1	.....	1	1872	12	.....	12
1821-30	5	.....	5	1873	12	.....	12
1831-40	3	.....	3	1874	12	1	13
1841-50	12	.....	12	1875	13	2	15
1851	3	.....	3	1876	12	1	13
1852	4	.....	4	1877	4	1	5
1853	2	.....	2	1878	11	.....	11
1854	3	.....	3	1879	13	.....	13
1855	2	.....	2	1880	8	.....	8
1856	3	.....	3	1881	10	.....	10
1857	5	1	6	1882	14	6	20
1858	2	.....	2	1883	22	3	25
1859	5	.....	5	1884	23	3	26
1860	4	.....	4	1885	24	1	25
1861	2	.....	2	1886	28	2	30
1862	.....	.....	.....	1887	33	1	34
1863	.....	.....	.....	1888	28	3	31
1864	1	.....	1	Unknown.	15	2	17
1865	2	.....	2	Total	406	27	433
1866	3	.....	3				
1867	5	.....	5	Total New England	254	32	286
1868	6	.....	6				
1869	4	.....	4				
1870	10	.....	10				

Subsidiary water-works are those which derive their supply from the mains of some other adjacent works, but are otherwise independent systems.

TABLE 2—B.

MIDDLE STATES WATER-WORKS.—SUMMARY OF CONSTRUCTION BY STATES AND HALF DECADES.

[Subsidiary Water-Works are indicated by numerals in parenthesis.]

DATE	Water-Works Built in					Total Main works.	Total Main and Subs.	Totals N. E. States.
	N. Y.	N. J.	Penn.	Del.	Md. & D. C.			
Before 1800	1	1	1	.....	.....	3	3	1
1800-10	.....	2	2	1	1	6	6	2
1811-20	.....	.....	1	.....	.....	1	1	2
1821-30	1	.....	4	.....	.....	5	5	1
1831-40	1	.....	2	.....	.....	3	3	3
1841-50	3	1	8	.....	.....	12	12	3
1851-55	6	3	4	.....	1	14	14	9
1856-60	6	4	(1) 8	.....	1	(1) 19	20	7
1861-65	2	1	2	.....	.....	5	5	6
1866-70	11	.....	15	1	1	28	28	23
1871-75	25	(1) 3	(2) 36	.....	1	(3) 65	68	39
1876-80	(1) 20	8	(1) 19	.....	1	(2) 48	50	38
1881-85	(3) 41	(9) 13	(1) 34	1	4	(13) 93	106	72
1886-88	(4) 49	(1) 12	(3) 37	1	5	(8) 104	112	78
Total	(8) 166	(11) 48	(8) 173	4	15	(27) 406	433	286

Included in the total of 1886-88 are the following water-works of unknown dates, nearly all of which are known to belong to this period: New York 6, New Jersey 1 (subsidiary), Pennsylvania 8 main and 2 subsidiary works.

TABLE 4.—B.

MIDDLE STATES WATER-WORKS—SUMMARY BY STATES OF THE MAIN STATISTICS GIVEN IN TABLE 3.

State.	Pop'n on Water-Works 1880 census.	No. of Works.			Present Finances.		Miles of Mains.	Number of		
		Main.	Subs.	Total.	Cost.	Revenue		Taps.	Hy-dr'ts	Me-ters.
New York	3,062,204	166	8	174	$80,944,713	$7,000,897	3,226.54	388,909	27,781	27,432
New Jersey	644,250	48	11	59	16,074,291	1,945,027	1,032.87	69,168	7,672	4,809
Pennsylvania	1,875,188	173	8	181	38,525,581	4,600,175	2,471.37	325,694	17,500	912
Delaware	51,412	4	..	4	919,000	118,156	84.75	11,856	725	14
Maryland	385,271	14	..	14	11,558,679	861,406	484.50	72,299	1,404	824
(Dist. Col.)	147,293	1	..	1	8,500,000	500,000	128.	22,095	1,013	
Total Middle	6,165,618	406	27	433	$156,522,264	15,025,661	7,428.03	890,021	56,095	33,991
Total N. Eng.	2,409,359	255	32	287	84,902,725	6,412,624	5,290.70	315,404	32,300	37,913

Only 1 water-works, Washington, in District of Columbia.

TABLE 7.—B.

MIDDLE STATES—CLASSIFICATION OF WATER-WORKS BY SIZE OF TOWN IN 1880.

States.	1,000 or under.	1,000 to 3,000.	3,000 to 5,000.	5,000 to 10,000.	10,000 to 20,000.	20,000 or over.	Total No.
New York	20	68	33	28	12	13	174
New Jersey	7	18	9	16	9	7	59
Pennsylvania	18	81	33	31	9	9	181
Delaware	.....	2	1	.....	.....	1	4
Mary'd & D.C.	2	5	2	3	1	2	15
Total Middle S.	47	174	78	78	24	32	433
Total New Eng.	40	80	65	78	24	32	287

TABLE 3—B.

MAIN DETAILS OF THE MIDDLE STATES WATER-WORKS BY STATES.

Summarized according to Date of Original Construction, showing the Present Condition of Works started in each Decennial or Quinquennial Period.

[N. B. the figures opposite each date must not be taken as representing the condition of the works at that date, but merely as the *present condition* of works then existing.]

NEW YORK.

DATE.	Present Pop'n Supplied	No. of Works			Present Finances.		Miles of Mains.	Number of		
		Independent.	Subsidiary.	Total.	Cost.	Rev.		Taps.	Hdr'ts	Meters.
1787-50	1,446,669	6	....	6	$42,678,192	$3,120,920	783.68	190,691	9,388	19,966
1851-60	889,963	12	....	12	18,899,071	1,996,417	868.55	125,457	7,116	2,251
1861-70	129,961	13	....	13	2,619,376	262,597	207.45	13,736	1,780	1,211
1871-80	287,304	45	1	46	8,756,120	754,016	622.50	37,784	4,779	3,501
1881-85	170,616	41	3	44	4,430,790	493,207	452.61	15,564	2,762	311
1886-88	129,157	43	4	47	3,470,664	365,115	283.00	5,078	1,895	181
Unkno'n	8,474	6	....	6	81,500	8,625	8.75	560	52	11
Total	3,062,204	166	8	174	$80,944,713	$7,000,897	3226.54	388,909	27,781	27,432

NEW JERSEY.

1799-50	176,457	4	....	4	$3,382,526	$ 413,351	229.00	21,550	1,689	730
1851-60	279,450	7	....	7	8,819,000	1,028,200	416.16	31,903	3,428	2927
1861-70	1,751	1	....	1	50,000	11 000	10.00	350	13	—
1871-80	68,761	11	1	12	1,545,265	159,299	120.50	6,710	812	90
1881-85	85,531	13	9	22	1,625,500	231,677	159.25	5,914	1,075	974
1886-88	26,863	12	..	12	652,000	101,500	97.96	2,732	655	88
Unkno'n	5,437	....	1	1	—	—	—	—	—	—
	644,250	48	11	59	$16,074,291	$ 1,945,027	1032.87	69,168	7,672	4809

PENNSYLVANIA.

1761-50	1,241,879	18	—	18	$25,118,847	$3,121,917	1168.90	244,115	11,047	389
1851-60	101,707	12	1	13	2,093,000	286,715	230.30	15,057	844	85
1861-70	148,176	17	—	17	3,562,929	263,136	258.37	19,142	907	97
1871-80	215,898	55	3	58	3,927,825	462,076	440.95	30,578	2,243	179
1881-85	89,093	34	1	35	1,796,402	214,736	147.05	10,327	1,295	150
1886-88	64,063	29	1	30	1,951,578	210,530	210.75	5,798	982	12
Unkno'n	13,772	8	2	10	75,000	11,065	15.05	677	92	—
Totals	1,875,188	173	8	181	$38,525,581	$4,600,175	2,471.37	325,694	17,500	912

DELAWARE.

1804-50	42,478	1	...	1	$760,000	104,536	69.50	10,869	625	7
1851-60	.....	....	....	....	.....	.....	.....	.....	.....	.....
1861-70	3,700	1	....	1	112,000	8,000	8.50	507	40	.....
1871-80	.....	....	....	....	.....	.....	.....	.....	.....	.....
1881-85	2,811	1	....	1	23,000	3,200	3.75	240	29	7
1886-88	2,423	1	....	1	24,000	2,420	3.00	240	31	.....
Totals	51,412	4	....	4	919,000	118,156	84.75	11,856	725	14

MARYLAND and District of Columbia.

1807-50	332,313	1	....	1	10,886,979	702,100	358.00	66,089	1,062	784
1851-60	151,350	2	....	2	8,522,000	501,850	132.00	22,355	1,040	.....
1861-70	6,642	1	....	1	65,000	12,290	9.50	1,000	45	6
1871-80	19,352	2	....	2	220,000	17,000	60.00	3,300	30	.....
1881-85	14,300	4	....	4	210.000	15,700	30.50	1,115	162	25
1886-88	8,607	5	....	5	154,700	22,466	22.50	535	78	9
Total	532,564	15	....	15	20,058,679	1,361,406	612.50	94,394	2,417	824

[1 Water-works (Washington) in Dist. of Columbia, opened 1859.]

TABLE 6.—B.

MIDDLE STATES.—POPULATION STATISTICS IN RESPECT TO WATER-WORKS.

[The "town population" is in towns of 4,000 inhabitants or over.]

States.	Total Population.			'Town Population 1880.	No. of towns over 4,000.	Per cent. of total.	Pop'n on Water-works, 1886.			Av. pop'n on each Water works.	
	1870	1880	Inc. per cent.				Tot'l 1886 pop'n.	P. C. of		Main works only.	Main & sub w'ks together.
								Total pop'n.	Town pop'n.		
N. Y.	4,382,757	5,082,871	15.9	2,726,367	58	53.7	3,062,204	60.2	123.0	18,420	17,600
N. J.	906,096	1,131,116	24.8	586,547	28	51.8	644,250	57.0	109.8	13,400	10,900
Penn.	3,521,951	4,282,891	21.6	1,658,523	56	38.7	1,875,188	43.8	122.0	10,810	10,350
Del.	125,015	146,608	17.2	42,478	1	28.9	51,412	35 1	121.0	12,850	12,850
Md.	780,894	934,943	19.7	364,943	5	39.0	385,271	41.2	105.8	27,500	27,500
D. C.	131,700	177,624	34.8	159,871	2	89.9	147,293	83.0	92.0	147,293	147,293
Total Middle S.	9,848,413	11,756,053	19.4	5,538,729	150	47.2	6,165,618	52.5	113.1	15,190	14,220
Total N. E. States	3,487,924	4,010,529	15.0	1,989,339	114	49.6	2,409,359	59.8	120.6	9,441	8,391

New York, apart from New York and Brooklyn			7,490
Pennsylvania	"	Philadelphia	5,700
Maryland	"	Baltimore	4,060
Massachusetts	"	Boston	8,400

Compare also Table 13.

TABLE 5—B.

MIDDLE STATES WATER-WORKS—SUMMARY BY DATES OF FIRST CONSTRUCTION OF THE MAIN STATISTICS OF ALL MIDDLE STATES WATER-WORKS, AS GIVEN IN TABLE 3.

DATE.	Present pop'n of water-works.	No. of Works. Main.	Subsidiary.	Total.	Present Finances. Cost.	Revenue.	Miles of mains.	Number of Taps.	Hydr'ts.	Meters.
1798-1850	3,239,796	30	.....	30	$82,826,544	$7,552,824	2,609.08	533,323	23,811	21,876
1851-60	1,422,470	33	1	34	38,333,071	3,813,182	1,647.01	194,772	12,428	5,263
1861-70	290,230	33	.....	33	6,409,305	587,023	493.82	34,735	2,884	1,314
1871-80	591,375	113	5	118	14,449,210	1,392,391	1,243.95	78,372	7,864	3,770
1881-85	362,951	93	13	106	8,094,692	958,520	793.16	33,160	5,325	1,467
1886-88	231,113	90	5	95	6,252,942	702,031	617.21	14,383	3,641	290
Unkno'n	27,683	14	3	17	9,156,500	19,690	23.80	1,276	144	11
Total	6,165,618	406	27	433	156,522,264	15,025,661	7,428.03	890,021	56,095	33,991

N. B.—This table does not represent the status of the works at the several dates (except as to number) but the statistics for the *current year* of works first opened at the several dates.

TABLE 8—B

MIDDLE STATES WATER-WORKS—COST AND REVENUE PER HEAD, TAP, MILE OF MAIN, ETC.

	Cost per head on water-works.	Cost per mile of main.	Cost per tap.	Revenue per head on w'ter w'ks.	Revenue per mile of main	Revenue per tap.	Population on water-works. per tap.	Population on water-works. per meter	P. C. rev. to Cost.
New York.....	$26.40	$25,100	$207	$2.28	$2,170	$18.00	7.9	112	8.65
New Jersey....	24.90	15,590	232	3.02	1,885	28.10	9.3	134	12.10
Pennsylvania..	20.50	15,580	118	2.45	1,860	14.12	5.7	2040	11.92
Delaware	17.85	10,820	77	2.29	1,593	10.00	4.3	3660	12.84
Maryland	29.90	23,800	160	2.23	1,775	11.90	5.3	467	7.45
Dist. Columbia.	57.80	66,400	385	3.40	3,900	22.60	6.6	.....	5.88
Av. Middle Sts.	25.40	21,000	176	2.43	2,023	16.90	6.9	181	9.40
Av. New Eng.	35.30	16,080	269	2.66	1,273	20.30	7.6	63	7.54
N. Y. W. W'ks.	33.10	64,500	222	2.23	4,350	14.96	6.7	67	6.74
Phila. "	17.73	17,120	92	2.40	2,315	12.40	5.2	3340	13.55
Baltimore "	32.75	30,450	165	2.38	2,215	11.05	5.0	424	7.27
Boston.....	53.90	44,700	352	3.52	2,920	23.10	6.6	117	6.52

TABLE 9-B.

MIDDLE STATES WATER-WORKS.—KIND OF WORKS.

STATE	Gravity	Pumping to Reservoir.	Tank.	Stand-Pipe	Direct.	Unkno'n	Total	P. C. gravity works.
New York ...	80	33	13	17	26	1	170	47.0
New Jersey..	10	16	4	14	3	1	48	20.8
Pennsylvania.	79	60	15	10	9	2	175	45.1
Delaware....	.....	2	.....	1	1	.....	4	0.0
Md. and D. C.	6	5	1	2	1	.....	15	40.0
Total Middle S	175	116	33	44	40	4	412	42.4
Total N. Eng.	130	50	21	31	21	5	258	50.4

As some of the works have a double system, the totals exceed that of Table 4-B. Several other gravity works have small auxiliary pumping systems for special service which have been disregarded, and others have small or very rarely used auxiliary systems which have been disregarded.

TABLE 11-B.

AVERAGE WORKING PRESSURES OF MIDDLE STATES WATER-WORKS.

[Representing in some of the gravity works the mean pressure in the mains. In pumping works, however, and in most of the gravity works, the pressure is that at the pumps, or principal mains, and hence considerably higher than the effective pressure.]

PRESSURE lbs. per sq. in.	N.Y.	N. J.	Pa.	Del.	Md. and D. C.	Total	Total N. E.
Under 20	2	1	3	1	.....	7	1
20-29	4	5	8	1	1	19	3
30-39	7	10	13	.....	2	32	18
40-49	19	15	15	1	1	51	24
50-59	14	5	20	1	2	42	35
60-69	21	3	20	.....	2	46	34
70-79	18	4	23	.....	.....	45	37
80-89	24	2	15	.....	1	42	19
90-99	11	.....	9	.....	4	24	23
100-109	8	.....	7	.....	1	16	6
110-119	6	.....	8	.....	.....	14	3
120-129	4	.....	9	.....	.....	13	8
130-139	2	.....	1	.....	.....	3	1
140-149	1	.....	.....	.....	.....	1	1
150-159	2	.....	3	.....	.....	5	1
160-169	.....	1	1	.....	.....	2	.....
170-179	1	.....	2*	.....	.....	3	1
Total works reporting	144	46	157	4	14	365	215
Av. pressure lbs.	72.5	47.4	71.8	28.0	65.9	68.3	72.5

*Said to be over 200 lbs. pressure.

TABLE 10-B.

MIDDLE STATES WATER-WORKS—SOURCES OF SUPPLY.

STATE.	S'rface	Spr'gs	Brook	River	Lake	Creek	Wells	Unk'n	T'tal
New York.....	30	43	12	31	15	20	27	2	170
New Jersey....	3	6	9	15	*1	3	11	.....	48
Pennsylvania...	10	50	22	39	2	35	13	2	173
Delaware. ...	.....	.....	.....	.....	.....	2	2	.....	4
Md. and D. C....	1	4	1	4	.....	1	5	.....	16
Total Middle S	34	103	44	89	18	61	58	4	411
Per cent.....	8.3	25.1	10.7	21.6	4.4	14.8	14.1	1.0	100.0
do. New Eng.	14.0	17.4	16.3	14.0	27.1	.....	7.7	3.5	100.0

* Including 14.7 per cent. of so called "ponds", really lakes.

The totals exceed slightly the total number of works, as some works have a double source of supply. Where the second source of supply is of quite minor importance, however, it has been generally disregarded. One "canal" supply in New York has been classed with surface water.

TABLE 12-B.

FIRE PRESSURE OF MIDDLE STATES WATER-WORKS, WHEN THE SAME ARE HIGHER THAN THE NORMAL WORKING PRESSURES.

[Nearly all the following are pumping works, but there are a few gravity works which are able to turn on a higher fire pressure from higher reservoirs.]

FIRE PRESSURE lbs. per sq. in.	N. Y.	N. J.	Pa.	Del.	Md. and D. C.	Total	Total N. E.
.....	.....	.....	2	.....	.....	2	3
40-49	.....	4	.....	.....	1	5	2
50-59	5	4	3	.....	.....	12	2
60-69	6	1	5	.....	.....	12	5
70-79	7	3	7	1	.....	18	7
80-89	2	.....	7	.....	.....	9	11
90-99	9	1	5	1	1	17	3
100-109	1	3	2	.....	.....	6	6
110-119	9	2	3	.....	3	17	3
120-129	5	.....	3	.....	.....	8	2
130-139	2	.....	2	.....	.....	4	4
140-149	5	.....	4	.....	1	10	1
150-159	1	.....	.....	.....	.....	1	.....
160-169	.....	.....	.....	.....	.....	.....	1
170-179	2	.....	1	.....	.....	3	.....
Total works reporting.	54	18	44	2	6	124	50

AMOUNT OF INCREASE ABOVE NORMAL PRESSURE.

10 lbs. or under	1	.....	8	.....	.....	13	8
10-19	4	3	5	.....	1	13	7
20-29	8	1	5	.....	1	15	7
30-39	4	.....	4	.....	1	9	10
40-49	10	4	6	2	.....	22	6
50-59	5	1	1	.....	2	9	3
60-69	7	2	4	.....	.....	13	4
70-79	4	.....	5	.....	1	10	5
80-89	7	3	3	.....	.....	13	1
90-99	1	.....	.....	.....	.....	1	.....
100-109	2	.....	2	.....	.....	4	.....
110-119	1	.....	.....	.....	.....	1	.....
120-129	.....	.....	1	.....	.....	1	1
Total works reporting	54	18	44	2	6	124	52

TABLE 14-B.

MIDDLE STATES WATER-WORKS REPORTING OVER 100 METERS IN USE.

	No. Meters	Total for State.
NEW YORK		
New York.....	18,000	
Syracuse....	400	
Utica.....	1,500	
Brooklyn....	2,021	
Auburn.....	400	
Binghamton	203	
Poughkeepsie.....	530	
Rochester....	1,500	
Yonkers.....	1 538	
Irvington.....	100	
New Rochelle.....	120	
Flushing.....	140	
55 others	1,035	27,487
(107 without meters)		
NEW JERSEY		
Morristown.....	250	
Newark	432	
Jersey City	217	
Hoboken.....	2,067	
Bayonne City.....	500	
East Orange.....	150	
Princeton.....	220	
19 others.....	373	4,809
(33 without meters)		
PENNSYLVANIA		
Philadelphia.....	253	
McKeesport	120	
44 others	559	912
(135 without meters)		
MARYLAND and D. COL'B'A		
Baltimore.....	784	
6 others.....	40	824
(8 without meters)		
DELAWARE		
2 works.....	14	

SUMMARY		
22 works with over 100 meters		32,045
124 " " under " "		2,001
287 " " no "		.....
433 works in all.....		34,046
130 New England works have		37,913

See also Table 14½-B.

TABLE 13—B.

OWNERSHIP OF MIDDLE STATES WATER-WORKS, WITH POPULATION SUPPLIED BY PUBLIC WORKS, ETC.

	N. Y.	N. J.	Pa.	Del.	Md. & D. C.	Total.	Total N. Eng.
City or town	69	20	41	3	4	137	119
Local company	87	25	124	1	11	248	149
Outside company	1	—	—	—	—	1	9
Individuals	11	2	6	—	—	19	8
Unknown	—	1	2	—	—	3	2
Total No.	168	48	173	4	15	408	287
Population supp'd by public works	2,594,398	409,453	1,279,006	47,712	498,958	4,829,527	1,740,574
Total pop'n on W. W's.	3,062,204	644,250	1,875,188	51,412	532,564	6,165,618	2,409,359
P. C. supplied by city works	84.7	63.5	68.1	92.6	93.9	78.3	72.3
Pop'n on private w'ks.	467,806	234,797	596,182	3,700	33,606	1,336,091	668,785
Pop'n per private w'k.	4,725	8,380	4,510	3,700	3,055	4,930	3,980
P. C. of total city pop'n supp'd by p'blic w'ks.	95.3	69.9	77.0	112.0	136.6	85.2	87.5

TABLE 16.—B.

MIDDLE STATES WATER-WORKS.—PUMPING MACHINERY.

Makes of Pumps (arranged alphabetically.	No of Pumps.						Capacity, millions of gallons.						
	N. Y.	N. J.	Pa.	Del	Md.& D.C.	Total	N. Y.	N.J.	Pa.	Del	Md.& D.C.	Total	Total N. E.
Blake	3	6	6	1	—	16	3.1	19.5	2.7	0.8	—	26.1	21.4
Cameron	—	—	4	—	—	4	—	—	1.6	—	—	1.6	—
Corliss	—	—	2	1	—	3	—	—	12.0	10.0	—	22.0	20.0
Cornish	—	2	4	—	—	6	—	9.0	10.3	—	—	19.3	9.0
Davidson	7	1	2	1	1	12	21.5	3.0	2.0	1.8	0.4	28.7	12.5
Deane	6	—	6	—	2	14	12.5	—	6.4	—	0.5	19.4	39.5
Galloway	—	1	—	—	—	1	—	6.0	—	—	—	6.0	—
Gordon & Maxwell	2	2	3	2	—	9	1.4	3.0	3.3	0.8	—	8.5	—
Holly-Gaskill	37	6	9	2	4	58	122.0	3.3	23.6	1.0	7.0	156.9	17.5
Knowles	7	1	19	—	—	27	6.5	0.1	25.5	—	—	32.1	19.5
Lang	4	—	1	—	—	5	8.0	—	0.2	—	—	8.2	6.5
Lowry	—	—	1	—	—	1	—	—	10.0	—	—	10.0	—
Volker & Felt'n	3	—	—	—	—	3	5.5	—	—	—	—	5.5	—
Wetherill	—	1	2	—	—	3	—	2.0	10.0	—	—	12.0	—
Wood	5	—	—	—	—	5	6.0	—	—	—	—	6.0	9.5
Worthen	1	1	—	—	—	2	5.0	0.5	—	—	—	5.5	—
Worthington	37	39	51	1	5	133	96.2	103.8	131.0	5.0	8.6	344.6	123.8
Wilson & Snyder	—	—	4	—	—	4	—	—	6.6	—	—	6.6	—
Miscellaneous	30	12	53	—	3	98	79.0	26.8	154.7	—	1.7	262.2	62.9
Totals	142	72	167	8	15	404	366.7	177.0	399.9	19.4	18.2	981.2	342.1

TABLE 14½.B.

PERCENTAGE OF METERS TO TAPS IN VARIOUS MIDDLE STATES WATER-WORKS HAVING A LARGE NUMBER OF METERS, INCLUDING ALL THOSE WHICH HAVE MORE THAN ONE-SIXTH OF THEIR TAPS METERED.

Towns.	Per cent. of taps metered.	Towns,	Per cent. of taps metered.
New York, N. Y.	10.0	Morristown, N. J.	31.2
Syracuse, "	16.0	Newark, "	3.5
Utica, "	57.7	Hoboken, "	48.0
Brooklyn, "	2.5	Bayonne City, "	95.3
Poughkeepsie, "	29.6	East Orange, "	18.7
Flushing, "	15.6	Perth Amboy, "	20.2
College Point, "	16.7	Princeton, "	91.2
Rochester, "	13.6	Red Bank, "	29.3
Yonkers, "	72.3	Dover, "	40.0
Irvington, "	100.0	Philadelphia, Pa.	0.15
Waterford, "	17.6	Baltimore, Md.	1.2
New Rochelle, "	84.6		

PUBLICATIONS RECEIVED.

Annual Report of the Philadelphia Department of Public Works and of the Bureau of Water. This is the report for the year ending Dec. 31, 1887, and is a book of 292 pages, giving the work done by the several bureaus, and the present extent and condition of the different classes of public works. There are numerous tables of pumping engine performance, rainfall, etc., and a tabular description of the machinery of the Water Department.

Scale of Proportional Inches.—By L. F. RONDINELLA, M. E., Professor of Drawing in the Philadelphia Manual Training School. F. Weber & Co., Philadelphia.; Bristol board, 12 ins. long; each, 10 cts.; Boxwood, flat, opposite bevel, 12 ins. long each, 80 cts.

The designer says: "This scale is designed especially for the use of mechanical engineers and machine draughtsmen. The civil engineer has his chain scale of feet or inches divided decimally, the architect his scale of *proportional feet* where the unit (¾ in., 1 in., 1½ in., etc.), represents 1 ft, and is divided into twelve parts for inches. But the mechanical engineer, though working almost exclusively in inches in his designs, is usually obliged to use the architect's scale, transforming each size from inches to feet and inches before laying it down on his drawing, with considerable loss of time and liability to error; while the scale that is perhaps most used by machine draughtsmen—half-size—is entirely absent from the architect's scale as usually made.

The scale of proportional inches is therefore introduced to mechanical engineers and machine draughtsmen as supplying a need that has long been felt. It contains the scales that are most used in practice—full-size, half-size, quarter-size, and eighth-size—in *inches*. The divisions are arranged as in the architect's scale, two scales on each edge, the unit outside of the zero point being subdivided in the larger sizes to sixteenths, in the smaller sizes to eighths. The graduations are U. S. Standard, engine divided, and the scale is furnished in best quality bristol board or boxwood.

Catalogue of Chemical Apparatus.—A priced and illustrated catalogue of chemical apparatus, assayers' materials and general laboratory supplies. James W. Queen & Co., Philadelphia, Pa. Price, 50 cts.

This publication is a very elaborate catalogue of 364 pages, with about 1,200 illustrations of all kinds of apparatus for laboratory and general chemical work, from tubes, retorts, etc., to complete plants for making different analyses, etc. The prices are given in detail. There is a good index, and a list of works on chemistry assaying, mining, etc. With the catalogue there is a pamphlet on "The Manufacture of Scientific Apparatus", descriptive of all works of Queen & Co.

Journal of the Franklin Institute, December, 1888. "An Investigation of the Construction of the Various Kinds of Cupolas that have been used for the Melting of Pig Iron", W. F. DURFEE; "Feasibility of Underground Railway in Philadelphia", LEWIS M. HAUPT; "Indeterminate Multipliers for the Continuous Girder", C. H. LINDENBERGER; "Electric Welding", C. J. H. WOODBURY; "A Perfect Substitute for Glass as a Support for Gelatine Bromide of Silver for use in Photography", JOHN CARBUTT.

Meter Tables.—Giving number of U. S. galls. for each cubic foot, from 1 to 1,000,000, GEO. A. ELLIS, C. E. Published by the American Frost Meter Co., of Boston, Mass.

This is a book of about 40 pages, 7⅛ x 11¾; the first few pages are devoted to a brief discussion of the water meter question and an illustrated description of the Frost meter, with testimonials from English water-works. There are also tables of tests of this meter and a summary of the accuracy tests made by the Meter Testing Commission at Boston, with a large folding table of extracts from the report of this commission. The "meter tables" occupy 20 pages.

ENGINEERING NEWS.

THE PANAMA CANAL LOCK GATES, now being made by M. EIFFEL under his contract with the Canal Co., weigh 230 tons each for the up-stream gates which are 33 ft. high 78.7 ft. long, and 10 ft. thick. The down-stream gates are 68.8 ft. high, 78.7 ft. long and 13.1 ft. thick. Three of the up-stream gates are completed and two of them have been taken to pieces and are ready to ship, according to the last issue of *Le Genie Civil*. These gates are really rectangular caissons of iron with vertical sides, with a "working chamber" 6 ft. high at the bottom and two shafts with air-locks. They are braced in the interior by horizontal and diagonal plates. The detail for rolling these gates out at right angles to the axis of the canal are not yet given.

THE PREVENTION OF END COLLISIONS is the purpose of an invention now being experimented with on the Harlem R. R. The signal consists of a chamber, which is filled with a red fluid, and a perpendicular glass tube about 18 ins. in length. When a train passes it strikes a trip and forces the fluid to the top of the tube. The fluid gradually recedes from the tube, and it takes 10 minutes to empty it. With the aid of a graduated scale any train, on arriving at the signal, can tell how many minutes have elapsed since the train ahead of it passed. The signal is working admirably.

THE IRON CHAIRS, fouund so thickly scattered along the Champs Elysées in Paris, belong to the municipality. There are 7,500 of them and the right to control them for 4 years is sold at auction at a price not less than $9,000. The lessee may demand 1½ cts. for the use of an armchair and 1 ct. for a plain chair: but he must also keep them in good order.

A MISSOURIO RIVER CUT-OFF CANAL, projected at Leavenworth, Kansas, is being engineered by Gen. MCCOOK. The plan is to cut off the U of 1¼ miles long near Fort Leavenworth, and prevent the further destruction of valuable land damaged by this great bend.

THE POUGHKEEPSIE BRIDGE is rapidly approaching completion; the ties are all placed on the bridge, the footways laid and the hand-rail up. The western viaduct approach is complete, and work on the east is being pushed. On the railroad connections over 2,000 men are said to be employed.

SOCIETY PROCEEDINGS.

Engineers' Club of Philadelphia.—Record of business meeting, Dec. 1, 1888. President JOSEPH M. WILSON in the chair; 24 members and 2 visitors present. The following were elected Members: SANFORD K. CAMPBELL, CLIFFORD STANLEY SIMS, JR., JOHN H. WEBSTER, JR., WALTER BRINTON, ALBERT S. COFFIN, CHARLES SILLIMAN and FREDERICK B. MILES; *Associate Member*, Prof. C. HERSCHEL KOYL.

The Secretary presented, for Mr. HEBER S. THOMPSON, a paper on "Earth Embankments for Reservoirs." Plans and sections were shown of a reservoir built by the writer for the Girard Water Co. on the Girard estate. Mr. HOWARD MURPHY discussed this subject, presenting an informal account of a recent accident to a part of one of the basins of the reservoir at Roanoke, Va., when, after the explosion of a magazine containing 3 tons of dynamite and 400 kegs of powder, within 2,500 ft. of the reservoir, a portion of the embankment of the south basin dropped into a limestone cavern or crevice, which was already known to exist under that portion.

Mr. J. F. RONDINELLA exhibited and described the "Scale of Proportional Inches" which he has prepared. Mr. J. E. CODMAN presented a further discussion of his recent paper on "Indicator Cards from Compound Engines, Showing Expansion through High and Low Pressure Cylinders." HOWARD MURPHY, *Secretary and Treasurer.*

Engineers' Club of Cincinnati.—The annual meeting was held Dec. 5, and Col. WM. E. MERRILL, the retiring president, made an address. The following were elected officers for 1889: President, G. BOUSCAREN; Vice President, G. B. NICHOLSON; Directors WM. E. MERRILL, LATHAM ANDERSON and R. L. READ; Secretary and Treasurer, J. F. WILSON.

Indiana Society of Civil Engineers, and Surveyors.—An adjourned meeting was held Dec. 11 and 12, in connection with the Tile Makers and Drainage Association. The annual meeting of the Society will be held Jan. 15, 16, and 17, 1889.

Canadian Society of Civil Engineers.— The Nominating Committee having recommended the following list of officers and members of Council for the year 1889, the Council now submits the same to ballot:

President, J. GZOWSKI, Toronto.

Vice Presidents, E. P. HANNAFORD, Montreal; H. F. PERLEY, Ottawa; P. A. PETERSON, Montreal.

Treasurer, H. WALLIS, Montreal.

Secretary, H. T. BOVEY, Montreal.
Librarian, F. CHADWICK, Montreal.
Members of Council, G. F. BAILLARGE, Ottawa; J. D. BARNETT, Stratford; K. BLACKWELL, Montreal; ST. G. BOSWELL, QUEBEC; F. R. F. BROWN, Montreal; G. C. CUNNINGHAM, Sherbrooke; E. GILPIN, JR., Bedford, N. S.; F. N. GISBORNE, Ottawa; W. J. JENNINGS, Toronto; G. A. KEEFER, Vancouver, B. C.; J. KENNEDY, Montreal; B. D. MCCONNELL, Montreal; M. MURPHY, Halifax, N. S.; J. E. VARIEN, Montreal; E. WEAGGE, Toronto.

New York Railway Club.—The next meeting will be held at the club rooms, 113 Liberty St., New York, Dec. 20, at 7:30 P. M. The subject for discussion will be "Car Wheels and Axles for 60,000-lb. Freight Cars." J. H BARR, Superintendent of Motive Power of the Chicago, Milwaukee & St. Paul Railway, will open the discussion, and will give his experience with the "contracting chill" process of making wheels, concerning which much interest is felt among railway men.

C. A. SMITH, *Secretary.*

Iowa Surveyors' & Civil Engineers' Association.—The fifth annual meeting will be held in the office of the Polk Co. Surveyor, at Des Moines, Ia.; beginning Tuesday Jan. 8, at 2 P. M. All members are requested to be present; engineers and surveyors are invited to attend and to present papers and take part in the discussion. There will be no reduced railway fares.

SETH DEAN, *Secretary*,
Glenwood, Ia.

Engineers' Club of Kansas City.—A regular meeting was held Dec. 3; G. W. PEARSONS in the chair and 6 members and 3 visitors present. CLARENCE A. BURTON read a paper on "The Steam Engine; its Beginning Growth and Place among the Industries of To-Day."

The annual meeting was held Dec. 5; President WM. B. KNIGHT in the chair; 14 members and 2 visitors present. Reports for the past year were presented by the Executive Committee and the Committee on Bridge Reform.

The Architectural League of New York has been incorporated, with the following Trustees: JOHN BEVERLY ROBINSON, EDWARD H. CLARK, JOHN GELLATLY, ARNOLD W. BRUNNER, WILLIAM C. HAZLETT, FRANK A. WRIGHT, H. O. AVERY, CHARLES J. BERRY, FREDERICK CROWNINSHIELD, JOHN P. RIELLY and J. D. HUNTER.

The National Association of Builders is to hold its next convention in Philadelphia, commencing on the second Tuesday in February, 1889. The attention of builders and parties interested with them is called to this meeting, and representatives are invited to attend from all regularly organized exchanges, etc., or from individuals interested. The important topics for discussion and action will be uniform contracts, the apprentice system, lien laws, rules or estimating work, permanent arbitration with employés, uniformity of measurements, uniform size of brick, insurance against accidents to the public; securities furnished for contractors on submitted estimates or contracts, establishment of trade schools, profit sharing, etc ,etc.

Master Car Builders' Association.—The following circular as to the marking of cars has been issued:

At a meeting of the International Association of Accountants, held last June, the following resolutions were adopted:

"WHEREAS, The rules of the Master Car-Builders' Association in regard to the proper marking of freight cars are being violated by various railroads and private car lines; therefore,

"RESOLVED, That it is the sense of this Association that immediate steps be taken to prevent the placing of elaborate and superfluous marks and the names of more than one railroad, also misleading advertisements, upon freight cars, and that our Secretary is hereby directed to communicate with the Secretary of the Master Car-Builders' Association and respectfully ask that these rules be strictly complied with; and further,

"RESOLVED, That members of this Association who are connected with roads which are guilty of the above violation, be requested to take this matter up with the proper officers of their respective roads, and endeavor to have the evil remedied."

The above resolutions were presented to the Executive Committee of the Master Car-Builders' Association at its last meeting, and the Secretary was then instructed to prepare a circular giving a statement of the above action of the International Association of Car Accountants, and announcing that the Executive Committee respectfully calls the attention of members of the Master Car-Builders' Association to its action with reference to the adoption of standards for marking cars, and would suggest that these standards be conformed to as far as is practicable.

The following are the standards adopted by the Association:

MARKING CARS.—A resolution was adopted at the 16th Convention, requesting all railroad companies whose initials are the same as those of other railroad companies, to stencil the name of the road in full on some part of the car where it can readily be seen by freight agents.

SYSTEM OF LETTERING AND NUMBERING FAST FREIGHT LINE CARS.—At the 18th Convention, held in Saratoga, the following resolutions were adopted, which describe a proposed system of lettering and numbering "Fast Freight Line" cars:

1st. The half of sides of car on which the doors do not slide, to show the name of the "Fast Freight Line" (spelled out in full) and the car number (in the Fast Freight Line series) immediately below it. In the same panel and within 2 ft. of the sill shall appear (in letters not over 4 ins. high) the name of the railroad company owning or contributing the car, and between the same and the sill shall appear the light weight of the car, with such other information as it is found advisable to give in connection with same.

2d. The doors should have no marks whatever.

3d. The ends to show the initials of the "Fast Freight Line" with the car number (in the Fast Freight Line Series) and the light weight just below them; no other marks will appear on ends of car.

4th. The half sides of cars on which the doors do slide, to be reserved for advertising symbols or trade-marks where used. The use of profuse lettering in this panel is to be discouraged, however, and it is recommended 'that only the simplest trade-marks or advertising signs should be used; the capacity of the car to appear near the sill in this same panel.

A Unique Menu.

The Arkansas Society of Engineers, Architects and Surveyors distinguished itself by the following ingenious bill of fare which we reprint verbatim. It is got up in the usual specification style, in all respects except that the page is smaller.

SPECIFICATIONS OF A BANQUET.

FOUNDATION.—The foundation shall consist of meats, laid as follows: Roast turkey, well set in cranberry jelly, with ornamental belt courses of roast venison, broiled ham and pickled ox tongue. The interstices to be well filled with chicken, shrimp and potato salad.

WATER TABLE.—Shall be of selected, well dressed celery, English chow chow, mixed pickles, French olives, Worcestershire sauce and cold slaw.

SUPERSTRUCTURE.—The superstructure to be of those ancient and substantial materials known as milk, rye and light bread.

ORNAMENTATION.—Ornamentation to consist of pyramids of meringue, pyramids of fruits, pyramids of wine jelly, ornamented angel food and ornamented sunshine.

INSIDE FINISH.—Inside finish to consist of pound cake, jelly tarts, egg kisses, almond and cocoanut macaroons, lady fingers and almond sponguelettes.

PLASTERING.—Center pieces to consist of oranges, bananas, apples, London layer rasins and Malaga grapes, to be well secured to ceilings and thoroughly fastened with Neapolitan ice cream, pine apple sherbet, fruit and homemade candies, crackers and cheese.

HARDWARE.—Will consist of the best selected mixed nuts, each opening to be provided with a full set of nut picks.

PAINTING.—The whole to receive two flowing coats of French coffee and as much water as may be necessary to make a good job.

GENERAL.—The whole to be under the immediate charge and supervision of FRED ROSSNER, architect to the Society.

CONSTRUCTION NEWS.

RAILROADS.

East of Chicago.

Existing Roads.

Baltimore & Ohio.—It is generally believed that at the election on Dec. 19, President SAMUEL SPENCER will be succeeded by CHARLES F. MAYER, who is the choice of the GARRETT party. It is understood that Vice President ORLAND SMITH will go out with Mr. SPENCER and that THOS. M. KING will be chosen First Vice President.

Louisville Southern.—It is announced that this road has been leased for 30 years to the Louisville, New Albany & Chicago Co.

Delaware & Hudson Canal Company.—Surveys are in progress for a branch from Gasset's Station on the Rutland Railroad (which line is to come under control of the Company in 1890) to Claremont Jc., N. H., just across the Connecticut river. At this point, connection would be made with the Boston & Maine system.

Pennsylvania.—Proposals have been called for by the company for the construction of a 7 mile branch from Latrobe, Pa., to the Hostetter Coke ovens in Amity township.——The Turtle Creek Valley road, which recently came under control of the company and on which all grading was stopped at the time of the deal, is to be built after all, and work has been resumed.

South Pennsylvania.—According to latest rumors, ANDREW CARNEGIE has increased his holdings of the stock until he now owns a controlling interest. It is rumored that he has bought up the stock in the interest of the Pennsylvania Railroad, and that therefore the road will not be finished. This however, Mr. CARNEGIE vehemently denies and he is reported as saying:

I want to see the road built, and will certainly use my influence to have a plan adopted that will eventually result in the building of the road. Many unlooked-for things have occurred that have given set-backs to the project. We were first going ahead under the Vanderbilt plan, but William H. Vanderbilt died, and then we took up the Hostetter plan; but Dr. Hostetter died recently, and the result has been that there has been another delay. But we by no means propose to abandon the project. Nothing can be done until the Vanderbilt and Pennsylvania Railroad differences are reconciled. But you can positively say that I am deeply interested in seeing the South Pennsylvania built, and that some plan will be adopted, though just how soon I am at present unable to say."

Binghamton & Williamsport.—The contractors for this Pennsylvania road, on which the commencement of grading was reported last week, are Belden & McTighe, of New York City. The estimated cost of the road is $3,000,000. The route adopted is *via* Towanda, where a bridge will be built across the Susquehanna river.

Buffalo, Rochester & Pittsburg.—The new railway line from Lincoln Park, near Rochester, N. Y., to Charlotte, reported last week, proves to be in this company's interest. A charter has been obtained for the Lincoln Park & Charlotte Railway Company, with ADRIAN ISELIN, Jr., as President and W. E. HOYT as Chief Engineer. A map of the proposed line has been filed, and it is understood that the right of way is about all secured.

Flint & Pere Marquette.—The citizens of West Branch, Mich., are anxious for the company to build a line to that point.

Lancaster & Hampden.—It is stated that this long delayed Ohio enterprise has been taken up by E. P. Buell & Co. of New York; and 18 miles from Lancaster to Tarlton will be built soon.

Sandy River.—A project is under discussion for extending this 2 ft. gauge Maine road which runs from Farmington to Phillips, Me., *via* Sharon, Rome and Belgrade to Augusta, over a route surveyed several years ago.

Maine Central.—The stockholders of the Dexter & Newport have voted to extend the lease of their road to this company for 999 years, provided the company will assume the subscription of the Dexter & Newport company to the Dexter & Piscataquis extension, of $5,000, and extend the time for completion of the latter to Dec 1, 1889. The State Railroad Commission has approved the location of the new road.

Boston & Maine.—The annual report to the Massachusetts State R. R. Commission for the year ending Sept. 30, shows gross earnings of $13,110,798 and expenses of $9,253,543, leaving net earnings of $3,875,254.

Canadian Pacific.—The city of Chatham, Ont., has voted a bonus of $40,000 to the company on condition that the Windsor extension is built through Chatham.

Central Railroad of New Jersey.—Surveys have just been made for a line from Point Pleasant, on the New Jersey coast, to Lakewood on the New Jersey Southern division, about 12 miles, giving another direct line from Philadelphia to the summer resorts on the coast. The country is level and favorable for construction.

The annual meeting of the Lehigh & Hudson River Company was held on Dec. 3, and directors were chosen representing the controlling interest recently acquired by the Central Railroad of New Jersey company.——The Orange County Railroad Company has been chartered to build a railway from Greycourt, the terminus of the Lehigh & Hudson, to Campbell Hall, N. Y., where direct connection is made with a line running to the Poughkeepsie bridge. EVERETT GARRISON, of Newburgh, N. Y., is Chief Engineer.

Western Maryland.—This company proposes to secure an independent entrance to Baltimore at an early date. It is estimated that the cost will not exceed $1,000,000. The company now uses the Pennsylvania terminals, paying therefor a rental of $81,000 for the current year.——A charter has been filed in Pennsylvania for an extension of the Baltimore & Harrisburg from Porter's Station to York, Pa., 14 miles.

New Projects and

Toledo, Indianapolis & St. Louis.—This company has been chartered in Illinois to build a railway from some point on the State line in Crawford county to East St. Louis, about 200 miles. The headquarters are to be at Robinson, Crawford Co., Ill. Among the incorporators are A. DALE OWEN, Orrville, O.; S. S. BURT, Chicago, Ill.; W. A. TILLOTSON, Detroit, Mich.; SAMUEL OWEN, Westfield, Ind.; and J. D. SHERMAN, Paw Paw, Mich.

Vincennes & New Albany.—Locating surveys are reported finished on this Indiana road, and construction will begin soon. About $230,000 has been raised in local aid.

Rockland, Rockport & Camden.—The stockholders of this Maine company held their annual meeting recently and a strong sentiment toward building the road was expressed. P. J. CARLTON, of Rockport, is President.

Rockland & Bangor.—A charter will be asked at the coming session of the Maine legislature for a railway from Rockland *via* Camden and Belfast to Bangor, by A. F. CROCKETT, J. T. BERRY and others.

Mt. Pleasant & Big Rapids.—It is reported that construction is to go forward at once on this Michigan road under direction of JOHN C. CARLAND, of Mt. Pleasant.

SOUTHERN.

Existing Roads.

Roanoke & Southern.—On this road, 17 miles, from Winston to Walnut Cove, N. C., on the Cape Fear & Yad-

kin Valley R. R., have been graded, rails and rolling stock have been purchased, and it is expected to have trains running by Jan. 1. The remaining 43 miles in this division, from Walnut Cove to Martinsville, Va., are under contract to the Virginia & North Carolina Construction Co., and work on the grading is to go ahead through the winter. The division from Martinsville to Roanoke will be put under contract sometime next year.

Lexington Terminal.—Grading on this short Georgia road is completed and rails and ties are to be purchased at once.

Pensacola & Memphis.

PENSACOLA, Fla., Dec. 10, 1888.

EDITOR ENGINEERING NEWS:—

The report that I had sold out my interest in the Pensacola & Memphis R. R. Co., was entirely without foundation. I am largely interested in the enterprise in many ways, and I do not even intend to sell or transfer my interest so long as the road is not completed. I being the projector of the line of road. S. N. VAN PRAAG,

Pres. S. & W. Land Devel. & R. R. Cons. Co.

Gulf & Ship Island. — The lease of 250 convicts employed by the company has been cancelled, it being claimed that the rules adopted for the treatment and government of the convicts had not been observed by the contractors. Work will continue on the line as usual. About 70 miles are graded and 22 miles of track are laid.

Carolina, Knoxville & Western. — Work is stopped on this road until the affairs of the company can be reorganized. A meeting of the directors held last week failed to reach any conclusion. It is desired to finish the first 20 miles of the line and raise money on that for the further extension of the road.

Western & Atlantic.—President JOSEPH E. BROWN has sent a communication to the legislature stating that the company lays claim to compensation for the betterments it has made upon the road, and desires to turn it over to the State at the expiration of the lease, Dec. 27, 1890, as it does not wish to renew the lease.

Kentucky Union.—On this road 36 miles, from Clay City to Three Forks, have been graded and the contractors are now at work on the division between Clay City and Winchester. Right of way is now being obtained from Winchester to Lexington. Three tunnels are in progress, one each in Breathitt, Wolfe and Powell counties, respectively 1,400, 1,200 and 800 ft. in length. Convict labor is employed on these, but the rest of the grading is done by hired workmen. About 3,000 men in all are now at work. It is believed that at the present rate of progress the road will be finished to Beattyville by next July.

Ohio Valley.—The opponents of the $400,000 subsidy recently voted to this company and the Cairo and Tennessee River railroad companies are taking steps to contest the legality of the tax in the courts.——President KELSEY will soon lay a proposition before the citizens of Vanderburgh county to build a bridge across the Ohio river just above Evansville, Ind., if the citizens will vote a subsidy of $100,000 in aid of the enterprise.

Owensboro, Falls of Rough & Green River.—The surveys for this Kentucky road were completed Dec. 8 and work on clearing the right of way began on Dec. 10.

Richmond & Danville.—At the annual meeting of this company, it was voted that bonds to the amount of $2,500,000 be issued to provide new equipment for the company.——An offer has been made to the citizens of Randolph county, N. C., to build a branch from High Point to Asheboro, if the county will subscribe $35,000.——In an interview with a reporter of the Atlanta *Constitution* JOHN H. INMAN, prominent in the Richmond Terminal management, stated that as the popular opposition to the consolidation of the Central of Georgia with the Richmond Terminal system was so great, it had been decided to stop the work on the extension from Eden to Americus and on some other branch lines which had been planned. The proposed bureau for the development of Southern manufacturing and mining interests would not be established at present.

Bangor & Piscataquis.—This road has just been leased to the Maine Central Co. at an annual rental of $12,500

New Projects and Surveys.

Kentucky.—Negotiations are in progress looking to a consolidation of the Bowling Green, Hartford & Ohio River, the Henderson, Bowling Green & Knoxville and the Henderson & State Line projects; and the efforts of the several companies will be united to secure the construction of a railway from Evansville, Ind., to Chattanooga, Tenn.

York Branch.—It is proposed to build a railway from York, Ga., to a point on the Georgia Central R. R., about 8 miles, and local aid is being secured. The line when built will probably be operated by the Central R. R. & Banking Co., of Georgia.

THE NORTHWEST.

Existing Roads.

Chicago, Rock Island & Pacific.—It is reported that steps have recently been taken looking to an extension of the branch which now terminates at Nelson, Neb., to Hastings. A report that the company has purchased the Kansas City, Wyandotte & Northwestern R. R. is denied by NEWMAN ERB, General Manager of the latter company. He states that the road is for sale, but will not be sacrificed for the sake of securing a purchaser.

Elgin, Joliet & Eastern.— This company has absorbed the Joliet, Aurora & Northern Railroad, and will operate it in connection with its own line. The general offices of the company are in the Royal Insurance Building, Chicago.

Duluth & Winnipeg.—Tracklaying has begun at Cloquet, Minn., and it is intended to push the work as far as possible this fall.

Indianapolis, Decatur & Western.—It is again reported that the long contemplated connection between this road and the Chicago, Burlington & Quincy system is to be made next spring. The Burlington Company will build the line from Quincy, Ill., to Beardstown and this company will build from Decatur to Beardstown.

Milwaukee, Lake Shore & Western.—The Mattoon Mfg. Co. is grading a branch from Aniwa, Wis., to their mills, 11 miles in length, which will be equipped and operated by this company. The line will be ready for the rails by Jan. 1.

New Projects and Surveys.

St. Louis, Quincy, Omaha & Sioux City.—This company, whose incorporation was reported last week has elected E. B. STEARNS of New York City, President; J. CLIFF RICHARDSON of St. Louis, Vice President; and THEODORE WEED, Secretary and Treasurer. The headquarters are to be at St. Louis. It is stated that the company is negotiating for the purchase of the Quincy, Missouri & Pacific road, which they propose to utilize for part of their proposed line.

Deadwood, Sturgis & Chamberlain.—This company has been chartered in Dakota with headquarters at Deadwood, I. K. P. MILLER and others are the incorporators.

Sioux Falls, De Smet & Northern.—

WINONA, Minn., Dec. 8, 1888.

EDITOR ENGINEERING NEWS:

The directors of this company held a meeting at Huron, Dak., on Dec. 6 to consider the formation of a construction company to push work in the spring. Owing to the illness of several important directors the meeting adjourned to meet in January in Chicago, at a date to be fixed by the President. M. S. PARKER, *Chief Engineer.*

THE SOUTHWEST.

Existing Roads.

Kansas City, Wyandotte & Northwestern.—This company has secured running rights over the St. Joseph & Grand Island Ry. from Seneca to Axtell, Kan., which will save it that much construction in pushing its extension from Seneca northwest into Nebraska.

Chicago, Rock Island & Pacific.—Three commissioners have been appointed to appraise the land damage by the extension of the line through the Cherokee Indian reservation in Indian Territory. The line is now completed to a point 30 miles south of Caldwell, Kan.

Kansas City & Pacific.—The last rails are just being laid on the extension to Paola, Kan., 32 miles in length. The trains will probably be run from Paola to Kansas City over the Kansas City, Ft. Scott & Memphis or the Missouri Pacific.

Kansas City, Ft. Scott & Memphis.—A delegation from Sarcoxie, Mo., recently visited Kansas City to induce President Nettleton to build a proposed branch from Joplin *via* Sarcoxie to Mt. Vernon, on the main line, a distance of about 60 miles. The matter was taken under consideration and an attempt will be made to secure local aid for the line.

San Antonio & Aransas Pass.—Grading will begin on the Waco branch early in January.

Kansas City & Southern.—Rumors are in circulation that a sale of this line to the St. Louis & San Francisco company will soon be effected. The "Frisco" would thus obtain an entrance to Kansas City.

Atchison, Topeka & Santa Fe:—The old story has been actively circulated during the past week that JAY GOULD had secured a controlling interest in the company. As this would require control of shares of stocks whose market value is at present about $20,000,000 and which could not be purchased without giving the stock a decided boom, the report may be safely set down as unfounded.

The gross earnings of the company for October show a decrease of $113,417 as compared with the same month last year. For the 10 months, the net earnings were $4,011,269, a decrease of $3,087,184 over the same period last year.

An official of the company is reported as saying that the present decrease is merely due to bad times, and further:

"Notwithstanding this, the company has not incurred a single floating debt and has declared its regular dividends. No railroads are making money at this season of the year. If they can pay expenses they are doing well. I do not think that any further reduction will be made in salaries, although a general weeding out of all unnecessary employés, such as was pursued by the Union Pacific a short time ago, may be followed. In such a case many clerks would be released. The construction expense will be done away with for next year and the cut in salaries and the weeding out policy will more than make up the present decrease in net earnings, while good crops and the absence of strikes and an advance in rates will make the outlook for next year promising."

New Projects and Surveys.

Galveston & Laredo.—A meeting was held in Galveston, Tex., Dec. 7, of several prominent business men of the city to discuss the project for a bridge from the island to the mainland and a railroad direct to Laredo. J. H. MARTIN of Chicago was present, and claimed to represent a syndicate which proposed to build the railway and bridges, and wished to ascertain what encouragement the city would offer to the enterprise. He exhibited plans for a bridge of an estimated cost of $790,000. It was generally agreed that if the syndicate would go ahead and build the bridge and the railway, the city would take the former off its hands when both were completed, at the cost price.

Ouachita Valley.—A company by this title has been organized at Monroe, La., to build the contemplated railway to Bastrop, mentioned last week. F. P. STUBBS is President, and C. H. TROUSDALE is Secretary.

Galveston & Western.—WALTER GRESHAM, J. C. LLAGUE, J. H. BURNETT and other capitalists of Galveston, Tex. have organized this company, and propose to build railway terminals within the city and extend the Texas Mexican Narrow Gauge, a 14-mile road on Galveston island.

New Orleans Belt.—The officers of the principal railways centering at New Orleans do not approve of the plans for a belt railway agreed upon by the commercial organizations of the city. They agree that a belt road is urgently needed for the transfer of freight; but also agree that the AUVRAY plan is wholly impracticable and can never be carried out.

ROCKY MOUNTAIN & PACIFIC.

Existing Roads.

Monterey & Mexican Gulf.

MONTEREY, Mex., Dec., 8, 1888.

EDITOR ENGINEERING NEWS:—

This road is now under construction from Monterey to Montemorilos, a distance of 56 miles, by M. & J. Sullivan & Co, under the Morris R. Locke & Co. Construction Co. Tracklaying will probably begin at some time during the month of December. Locating surveys are now in progress from Montemorilos *via* Linares to the city of Victoria. WM. H. WENTWORTH, *Engineer in Charge.*

Arizona Mineral Belt.—This road was sold by the Sheriff at Flagstaff, Ariz., on Dec. 4, and was bought by D. M. RIORDAN

Denver & Rio Grande.—The contract for ties for the branch to Lake City has been let to JAS. LACOUNT.

Mexican National.—Contractor CHAS. THORNTON has just finished grading on the branch from Vamyas to Charcos, about 26 miles, and tracklaying is in progress.——ARTHUR P. HERBERT has just completed the location of the extension from Manzanillo and Colima to Guadalajara.——A branch to Zacatecas is contemplated.

San Francisco & North Pacific.—Work has been delayed on the Cloverdale & Ukiah extension by a slide in the tunnel just above Cloverdale, caused by the heavy rains. About 14½ miles of track are laid, bringing the line nearly to Hopland.

Nevada & California.—Graders are making good progress on the northern extension, and the terminus is now at a point east of Honey lake. The line is projected to run north through California and Central Oregon to the Columbia river.

Union Pacific.—It is stated that this company has secured control of the Cuyamaca & Eastern railroad, under construction from San Diego, Cal., eastward.——Surveys are reported in progress for a branch of the Utah & Northern from a point near Silver Bow, Mont., westward into Idaho.

Rocky Fork & Cooke City.—It is said that the funds have been raised to complete this Montana road, and rails will be laid as soon as spring opens.

New Projects and Surveys.

Stockton, Fresno & Southern.—Chief Engineer E. E TUCKER has begun the locating survey on this California road and it is intended to begin grading at once. F. HOMER has the contract for grading. The general offices of the company are at 212 Sansome St., San Francisco, H. L. DAVIS is President.

Mexican Southern.—Locating surveys have been completed on this line, formerly known as the Oaxaca Railroad, from Tehuacan to Tecomovaca, 93 kilometres, and preliminary surveys have been made to Puebla. It is intended to begin construction early in 1889 and complete 228 kilometres in 18 months.

San Jose Motor.—A franchise has been granted at San Jose, Cal. to D. A. MALPAS, BOZO RADOVICH and others for a steam motor road from San Jose to Saratoga, about 10 miles.

Texas, Topolobampo & Pacific.—Capitalists are trying to raise funds in Kansas City for this proposed road in Mexico.

FOREIGN.

Turkey.—It is announced that the banking house of J. & W. Seligman & Co. has signed articles with the Porte for a junction of the Grecian and Turkish railway systems. The amount of capital involved in the new lines to be constructed is set at between $20,000,000 and $25,000,000.

Brasil.—Further particulars in regard to the proposed system in this country to be built under the auspices of a Canadian syndicate, are to the effect that its chief members are DUNCAN MCINTYRE and J. J. C. ABBOTT of Montreal and R. SANFORD FLEMING of Ottawa.

Contracting.

Street Sweeping.—The Board of Public Works, Jersey City, N. J., has awarded the contract for 1889 to J. G. Dunne, the lowest bidder. He will be paid $5 per mile for sweeping, $16,500 for removing ashes, and $2,750 for removing garbage.

The Hughes Steam Pump Co., of Cleveland, O., has issued an illustrated catalogue of improved steam pumps, and pumping engines, single and duplex patterns, for all kinds of work. Tables are given of the dimensions and prices of the different classes of pumps, and also sectional views of the single and duplex pump. There are 4 pages of "useful information," and directions for running the engines.

Stone, Sand and Cement.—The following proposals for materials required in the reconstruction of the breakwater at Buffalo harbor, N. Y., were opened Dec. 1 by Capt. F. A. MAHAN, U. S. Engineer Office, Buffalo, N. Y. Broken stone; Ira Farnsworth, $2 per cu. yd.——Rubble stone; John Gesl, Jr., $3 per cu. yd.; Ira Farnsworth, $3.50.——Removing and crushing stone from breakwater, Peter G. Straub, 50 cts. per cu. yd. for removing, 75 cts. per cu. yd. for crushing.——Sand; Fox & Holloway, 80 cts. per cu. yd.; W. E. Carroll, 90 cts.——Pebbles; W.E Carroll, $1.75 per cu. yd.; Wm. E. Hingstone, $1.95; Fox & Holloway, $2.——Natural cement; Union Akron Cement Co., 82 cts. per bl.; Johnson & Wilson, $1.—— Portland ce ment; Johnson & Wilson, $2.20 per bl.; E. Homer Crawford, $2.25; American Improved Cement Co., $2.37; Empire Cement Co., $2.45; Union Akron Cement Co., $2.45; Howard Fleming, $2.39 duty free, or $2.59 duty paid Emil Lenz, $2.46 duty fee, or $2.67 duty paid.

Pier Work.—At Bayonne, N. J., a new timber pier is being built at the foot of Ingham Ave., on the Kill von Kull. Engineers SMITH and WESTON prepared the plans and R. A. Young, of Elizabeth, is the contractor. The pier is to be 80 ft. wide, 175 ft. long on the easterly side and 150 ft. 3 ins. on the westerly side. It will extend out to the riparian line, in a southerly direction, where the water is about 25 ft. deep. On the east side of this pier the city owns 37½ ft., and on the west 80 ft. Inshore, 11 rows of spruce piles have been driven to a depth of from 6 to 8 ft., 17 piles to the row. Beyond that to the south and front will be 5 rows of white oak piles, braced and sheathed on both sides with white oak plank. This bracing will be 4 x 10-in. plank, bolted, from low water mark. The deck or surface will be nearly on a level with the street, and 5 ft. 6 ins. above high water mark. The contract price for the work is about $9,700.

Viaduct.—***South Omaha, Neb.***—The following pro posals for the construction of the Q St. viaduct across the Union Pacific and Union Stock Yard tracks, were opened Dec. 1, 1888, by D. F. BAYLESS, Chairman of the Committee on Streets and Alleys, all the bids having been thrown out on the letting of Nov. 24 and the work readvertised; the prices are complete for trestle and iron and steel spans: Mt. Vernon Bridge Co., Mt. Vernon, O.; $35,220 with wood hand-rails (iron rail on spans only), or $34,950 with iron hand-rail. Milwaukee Bridge & Iron Works, Milwaukee, Wis.; $33,000 with wood, $34,000 with iron rail. Missouri Valley Bridge Co, Leavenworth, Kan.; $29,900 or $31,000, $30,400 with posts for 50 ft. span Minneapolis Bridge Co., Minneapolis, Minn.; $34,200 or $35,000. J. W. Hoover, Kansas City, Mo.; $33,000 with wood (iron on spans only), or $34,500 with iron rail. Keystone Bridge Co., Pittsburg, Pa., $28,677.83 or $30,-451.10; 50 ft. girder and posts. C. A. Hubbard, Omaha, Neb.; $34,808 with iron rail; piers only, $8,300; trestle and grading, $9,200. Variety Iron Works, Cleveland, O.; $34,-500 with iron rail. King Iron Bridge & Mfg. Co., Cleveland, O.; $29,600, complete as per plan, iron rail, etc.; deduct $900 with iron rail on spans only, $28,700; deduct $1,400 with wood rail throughout, $28,200; deduct $400 for 3 ft. diameter piers under 50 ft. span, $29,200; deduct $1,000 for channel supports for 50 ft. span, $28,600; add $200 for plate girder 50 ft. span, $29,300; add $2,000 for iron joists on roadway of spans, $31,600; add $3,000 for iron floor joints on road and walks on spans only, $32,600. The contract was awarded to the King Iron Bridge & Mfg. Co., of Cleveland, O., at $31,300 for all complete, with iron rail on spans only, iron stringers on trusses, roadway and footwalks, grading, etc.

This viaduct will consist of about 570 ft. of pile trestle, also one 50 ft. through truss, one 106 ft. through truss, and one 150 ft. through truss; Total length of viaduct, about 876.1 ft.; total width, 32 ft. roadway, 22 ft. and two 5 ft. sidewalks; live load, 100 pounds per sq. ft.; dead load (on trestle), 50 pounds per sq.ft. Bonds to the amount of $35,000 have been voted for the construction of the structure. The work includes the foundation of piers, bulkheading at each end of trestle approaches to fills, dressing and painting of hand-rail (if of wood), grading of approaches, to the amount of about 10,200 cu. yds. of earthwork, and to complete said viaduct in a first class and substantial manner, ready for travel on or before June 1, 1889. For the three spans, THEODORE COOPER'S Specifications for Wrought-Iron and Steel Highway Bridges, Class A, (revised for 1888) are to apply. R. H. LAWRENCE is City Engineer.

Street Railway.—***Salem, Ore.***—O'Connor, Barr & Horrigan, who have contracts on the Oregon Pacific Ry., have been awarded the contract for the construction of the street railway at Salem, Ore., for $6,599.

Cable Railway.—***Denver, Col.***—The Denver Cable Ry Co. has awarded the contract for 31,000 yokes and other iron work to the Centropolis Car Wheel & Iron Co., of Kansas City, Mo., for $300,000.

Proposals for Water-Works.—***Las Animas, Col.***—Proposals will be received until Dec. 24 by FRANK GREYBILL, Chairman of the Water Committee. Work to be commenced in 60 days from contract and completed in 60 days after commencement. There will be 1,920 ft. of 8-in. pipe, 9,280 ft. of 6-in., and 11,940 ft. of 4-in. pipe; 40 double-nozzle frost proof hydrants, with 4-in. valves and 6 ft. stand-pipes; four 6-in. and two 4-in. valves; 40 crosses, and 1 stop-gate upon the pipe line to the reservoir. The test is to consist of four 1-in. streams through 100 ft. of 2½-in. hose, thrown to a height of 80 ft. The pumping plant will consist of 2 compound, duplex, non-condensing engines of first class make, each with a minimum capacity of 550,000 galls. per 24 hours; 2 return tubular boilers, 4 x 12 ft., 30 H. P. each, the tank will be of wood, 18 x 30 ft., with a capacity of 90,000 galls., supported on a timber trestle.

Metal Markets.—***Structural Iron.***—Prices are about as follows: in Philadelphia; 2c. @ 2.10c. for bridge plate; 2c. @ 2.10 c. for angles; 2.6c. @ 2.7c. for tees, and 3.3c. for beams and channels, iron or steel. Store prices are as follows in Chicago: angles, 2.35c. @ 2.50c.; tees, 2.60c. @ 2.70c., beams, 3.80c. Mill orders are taken at the following rates, f. o. b. Chicago: Angles, 2.15c. universal plates, 2.20c. @ 2.25c.; tees, 2.55c. @ 2.60c.; beams and channels, 3.40c. New York prices are: sheared plates, 2c. @ 2.1c.; universal mill plates, 2.1c. @ 2.2c.; angles, 2c. @ 2.10c.; tees, 2.5c. @ 2.6c., channels and beams, 3.3c.

Steel Rails.—New York, $27 @ $28. Chicago, $30. Pittsburg, $28. The situation is still not very clear but a raise of $1 to $2.50 has been made on the recent low figures. At Chicago heavy contracts are pending, and the local companies have made amicable arrangements for the division of business. Large sales have been made in the west. Eastern mills' sales have been made, aggregating about 8,000 tons, the greater part at private terms.

Railway Track Supplies.—Pittsburg, Pa.; spikes, $2.15, 30 days, delivered; splice bars, $1.85 @$ 1.90; track bolts, 2.85c. with square, and 2.95c with hexagon nuts.

Old Material.—Pittsburg, Pa., No. 1 wrought scrap, $21, net ton; wrought turnings, $13 @ $14; car axles, $25.50 @ $26.50; cast scrap, $15.50 @ $16, gross ton; cast borings, $12 @ $13; old car wheels, $19.50, $20. Open hearth scrap steel, $18.50 @ $19.25. Short pieces of old steel rails at $18.50 @ $18.75. Old rails; $23.25 @ $23.50 in New York; $25 @ $25.25 in Pittsburg. (Compiled from *Iron Age*, Dec. 13.)

Proposals Open.

Street Work.—Regulating, grading, curbing and flagging. THE COMMISSIONER OF PUBLIC WORKS, 31 Chambers St., New York City. December 20.

Water Bonds.—Bonds for $12,500. THE WATER COMMISSIONERS, Olean, N. Y. December 26.

Surveying.—To survey and plat all lots or parcels of ground situated in the territory annexed to the city of Baltimore, under an Act of the General Assembly of Maryland passed at January session, 1888, chapter 98. The boundary lines of each piece of ground to be marked in feet and inches upon plats, together with the superficial area thereof: also the names of the owner thereof, and the improvements located thereon. The work will be accepted and paid for 15 days after the same has been completed and the plats thereof, etc., deposited with the City Register, provided the same shall comply with the terms o the ordinance authorizing the work. The surveyor or surveyors to whom the work is awarded will have the exclusive right to sell copies of said plats on payment to the city of a royalty of $2 for each and every copy so sold. Each bid must be accompanied by a bond in the sum of $10,000, with not less than two responsible sureties thereon, and must state the time within which the work will be completed. JOHN A. ROBB, City Register, Baltimore, Md. December 26.

Water-Works.—At New Castle, Ind. The work will include 2,700 lin. ft. (115 tons) of 12-in. pipe, 760 ft. (25 tons) of 10-in., 2,120 ft. (53 tons) of 8-in., 9,160 ft. (175 tons) of 6-in., and 1,710 ft. (20 tons) of 4-in.; total 370 tons of pipe with 12 tons of special castings; laying pipe; furnishing two 12-in. valves, one 10-in., three 8-in., eleven 6-in. and seven 4-in.; 24 valve boxes and covers; 37 fire hydrants one building and smokestack; also non-compound, non-condensing steam pumping machinery, with a daily aggregate capacity of 1,500,000 galls., to have double or duplicate engines and pumps, susceptible of detachment so that either can be operated separately and independently of the other; also, two pumping engines, each with a daily capacity of 750,000 galls., the commissioners reserving the right to select such machinery as they may elect; 2 return tubular boilers, each approximately 54 ins. in diameter and 14 ft. long, including engine foundations and settings, and all pipe connections, valves, etc. J. D COOK, Toledo, O., Consulting Engineer. The WATER COMMISSIONERS, New Castle, Ind. December 28.

Water-Works.—At Goldsboro, N. C. Bidders must own and operate such works and must fix a price per hydrant for water to be furnished said city and its inhabitants for a term of 20 years. Specifications will be furnished upon application. T. H. BAIN, City Clerk, Goldsboro, N. C. January 1.

Electric Lighting.—For a term of 3 or 5 years from next May. THE BOARD OF PUBLIC WORKS, Nashville, Tenn. January 20.

GOVERNMENT WORK.

Levee Work.—In the YAZOO-Mississippi delta levee district. Capt. SMITH S. LEACH, U. S. Engineer Office, Memphis, Tenn. December 17.

Stone.—About 25,600 cu. ft. of granite dimension stones for the lock at the cascades of the Columbia river, Oregon. Major THOS. H. HANDBURY, U. S. Engineer Office, Portland, Ore., December 20.

Steel Gun Forgings.—Brig. Gen. S. V. BENET, Chief of Ordnance, War Department, Washington, D. C. December 20.

Jetties.—For the improvement of the Appomattox river. Lieut. G.J. FIEBEGER, U.S. Engineer Office, Norfolk, Va. January 3

Sandstone.—About 7,000 cu. yds. of dimension, footing and coping stone. Col. T. G. BAYLOR, U. S. Arsenal, Rock Island, Ill. January 3.

Cement.—About 5,000 bls. for the lock in the Kentucky river at Beattyville, Ky. Major D. W. LOCKWOOD, U. S. Engineer Office, Cincinnati, O. January 3.

Lighthouse Work.—Metal work and erection of lighthouses at Deer Id., Boston harbor, Mass.; Lubec Narrows, Me.; and Crabtree ledge, Frenchman's bay, Me. Major W. S. STANTON, U. S. Lighthouse Engineer (1st and 2nd districts), Boston, Mass. January 3.

Submarine Torpedo Boat.—THE SECRETARY OF THE NAVY, Navy Department, Washington, D. C. January 4

Dredging.—In Duck creek, Del., and in Choptank river and Cambridge harbor, Md. WM. F. SMITH, U. S. Engineer office, Wilmington, Del. January 7.

Dredging.—At Hyannis, Wareham and New Bedford harbors, Mass.; Newport harbor, R. I.; Pawtucket, Providence and Pawcatuck rivers, R. I. and Green Jacket, shoal, Providence harbor, R. I. Major W. R. LIVERMORE, U. S. Engineer Office, Newport, R. I. January 8.

Dam and Dike.—Dam across the the Monongahela river, 3 miles above Greensboro, Pa.——Crib work dyke, ballasted with stone, in the Allegheny river, at the mouth of Red Bank creek, 63¾ miles above Pittsburg. Lieut. Col. WM. E. MERRILL, U. S. Engineer Office, Cincinnati, O. January 8.

Dredging.—In Cape Fear river, below Wilmington, N.C. January 5.——In New river, N. C.; in Bogue sound, inland waterway between Beaufort harbor and New river. Capt. W. H. BIXBY, U. S. Engineer Office, Wilmington, N. C. January 9.

Bridges and Canals.

Illinois Ship Canal.—In accordance with the provisions of a recent act of congress providing for a survey of the route for the improvment of the Illinois & Michigan canal and the Hennepin canal, of the great national water way between the lakes and the Miselssippi river, for which an appropriation has been recently made, an engineer corps of 25, under Messrs. WHEELER and FLAGG, have been at work around Joliet, marking out a route for the proposed ship canal. One of the routes now being surveyed is along the channel of the Desplaines river, through which the Chicago sewage now flows, and the other is northeast of the city, down the Hickory creek valley.

Water Power Canal.—Work is progressing rapidly on the water power canal at Sault Ste. Marie, Mich. It will be 300 ft. wide for the greater part of its length. About 300 men and 100 teams are at work, and the rock excavation will be continued through the winter. The engineer, Col. RUGER, estimates that 28,000 H. P. can be supplied. The contract specifies that the work must be completed in August, 1889. The $100,000 subscribed by the citizens of Sault Ste. Marie has all been paid up, and a like amount has been put up by the water power company. The first $50,000 was raised July 15, and the second $50,000 the subscribers paid in Oct 15. For this they receive stock in the company at 50 cts. on the dollar. The money necessary for the completion of the canal will be secured by the sale of bonds. The city takes 400 H. P. per annum at $10 per H. P. and agrees to build the bridge over the canal.

Bridge Notes.—***Hartford, Conn.***—The Asylum St. bridge of the New York, New Haven & Hartford Railway was tested last week and showed a deflection of only ¼-in. of the main girders under a load of 355,980 lbs., returning to position when the load was taken off. The span is 77 ft. The bridge was built by the Berlin Bridge Co., of Berlin, Conn.

Saybrook, Conn.—Three spans, including the draw, of the $100,000 bridge over the Connecticut river for the Shore Line road, are completed, and work has been stopped until next spring, as the water is now too cold for the divers to work.

Buffalo, N. Y.—A bridge is proposed across the Niagara river to Grand Island. Judge H. J. SWIFT and ORSON BEDELL are interested.

Staten Island, N. Y.—The new Baltimore & Ohio bridge over Staten Island Sound is nearly finished. The trestle work, which is 5,900 ft. long and 30 ft. high, will be finished early this month. The Jersey approaches will be built on trestle work, 3,400 ft. long and 20 ft. high, crossing the Pennsylvania and Long Branch roads.

Philadelphia, Pa.—The Camden & Philadelphia Bridge Co. proposes to build a bridge across the Delaware from Market St., Philadelphia, to Market St., Camden, and another bridge from Walnut St., Philadelphia, to Federal St., Camden.

McKeesport, Pa.—The McKeesport & Monongahela Bridge Co. has made application for a charter. Its object is to construct a bridge over the Monongahela river from Market St., in McKeesport, to a point in Mifflin township opposite.

Toledo, O.—The Pennsylvania Company has finally made a contract for a new railway bridge over the Maumee. It will be higher than the one which was washed away and replaced by a trestle. The city has for some time past endeavored to have the company do this, and has at last succeeded.

Jeffersonville, Ind.—The building of the bridge between Jeffersonville, Ind., and Louisville, Ky., is again being agitated. The Pittsburg Coal Exchange has withdrawn its objections to the location and has communicated to the Secretary of War its opinion that the structure would not be dangerous to the coal fleets passing over the falls.

Asheville, N. C.—The West Asheville Improvement Co. will build a bridge over the French Broad river. E. G. CARMER is interested.

Decatur, Ill.—The Wabash Ry. is building a new iron bridge over the Sangamon river, to replace the present wooden structure.

Peoria, Ill.—The new free bridge was formally opened Dec. 4. The total cost is about $55,000, including $19,346 for timber, piers and substructure, $16,489 for iron work, and about $9,500 for road work and grading. The draw is guaranteed to work for 5 years.

Sioux City, Ia.—The new Chicago & Northwestern bridge across the Missouri river was tested and formally opened to traffic Dec. 5. Practical tests by engineers of the road were satisfactory. Nearly 100 railroad men were present from Chicago, Omaha and St. Paul. The bridge cost $1,500,000, and it has taken about 17 months to build it.

Wever, Ia.—The new iron bridge across Skunk river has been completed and was opened Nov. 27. It was built by the supervisors of Des Moines and Lee counties. The contract was awarded last summer to James B. Diver & Co., of Keokuk, Ia.; work was commenced on the foundations early in October and on the superstructure about the middle of that month. The bridge is 360 ft. long, with 2 spans; the three piers consist each of 2 iron tubes braced together; the roadway is 16 ft. wide. The contract price was $9,235, but the total cost will be about $10,000.

Carquinez Straits, Cal.—Some months ago the Southern Pacific made surveys for a suspension bridge across the Carquinez straits, and recently several eastern bridge builders submitted plans and specifications. The estimates ranged from $4,000,000 to $5,000,000 for a double track bridge. The plans called for 6 stone piers 35 ft. wide and 200 to 215 ft. high. Two of the piers were to be 115 ft. in height from the bottom of the bay up to high-water mark. The others would be of less height below the water, but all of them would stand out as very high columns above the water. The bottom of the straits is described as being favorable for such piers, being of a very hard stone strata.

Canal.—The Banana Creek Improvement, Canal & Transit Co. has been organized in Titusville, Fla., to dig a canal from the Mosquito lagoon to the Banana river. Work has been commenced.

Sault Ste. Marie Canal.—The contract recently let for excavation, timber work and other preliminary work for the canal on the Canadian side, amounts to about $1,290,000. The canal, lock and other work will cost $4,500,000, and will take 3 years to build.

Viaduct.—***Albany, N. Y.***—Among the many plans offered to the Hawk St. Viaduct Commissioners, two have been selected for which bids are now asked. The first is an arch plan, submitted by the Hilton Bridge Co., of Albany. This is the most satisfactory of the two plans, but may prove beyond the means of the Commissioners. Its main features are iron supports formed in arches, with stone approaches on either side. The other plan would make the viaduct resemble the elevated road structures, "and could not be considered beautiful, although it might be cheap." This is the Rochester Bridge Co's. design. The plans and specifications are now open for inspection and proposals will be received until Dec. 24.

Bridges.—***Kansas City, Kan.***—There are 12 bridges spanning the Kaw river from its confluence with the Missouri to Argentine, all inside the limits of the consolidated city of Kansas City, Kan. But this number is not sufficient for the traffic, and another wagon bridge will be constructed on the South side at the foot of Eighth St. The Kaw Valley Townsite Co. had dedicated property for the opening of Eighth St. from Cheyenne Ave. to the river and there is a movement among Rosedale and Armourdale people to erect a bridge at that point. The new 24th St. bridge is too far west for the convenience of the Rosedale people and they are anxious to secure a more direct route to the city.

WATER.

Electric Light.—***Massachusetts.***—Plymouth. The Plymouth Electric Light Co. has been incorporated by GEO. F. WESTON and others; capital stock, $30,000.——Lee. The Lee Electric Light Co. has been organized; capital stock, $10,000; President, WELLINGTON SMITH; Treasurer, DAVID DUNN.

New York.—Albany. The Edison Incandescent Light & Power Co. will extend its plant; there will be two 100 H. P. engines and 2 boilers, supplying power for 3,500 lights. J. F. BLACK has a contract for a well.——Brooklyn. The Vanderpoele Electric Mfg. Co., of Illinois, which now supplies electricity to the Jamaica electric road, has applied for a franchise for lighting streets in the 26th ward.——Albion. The Fort Wayne Jenney Electric Light Co. has submitted a proposition to furnish 20 arc lights of 2,000 c. p., and 50 incandescent lights of 25 c. p. each, for $2,000 per year.

Pennsylvania.—Kingston. The Heisler Electric Light Co., of St. Louis, Mo., has a contract for an electric light plant.——Beaver Falls. The Beaver Valley Electric Light & Power Co. has been incorporated by JOHN REAVES and others; capital stock, $12,000.

Ohio.—Newport. The Newport Electric Light Co. has been incorporated by A. S. BERRY, T. E. LIVEZAY and others; capital stock, $50,000.

Maryland.—Pocomoke City. It is proposed to establish an electric light system. Address the mayor.

Kentucky.—Maysville. The Maysville Electric Light & Power Co. has been incorporated to put in an Edison incandescent plant; GEO. S. ROSSER and W. W. BALL capital stock, $12,000.

North Carolina.—Goldsboro. The city has granted a franchise to Conway, Kelley & Co., of Lebanon, Ky., and has contracted for the city lighting.

Alabama.—Tuskaloosa. An 80 H. P. electric light plant will be put in by D. F. TORBETT.

Illinois.—Elgin. The City Council has awarded the contract for a complete plant to the Jenney Electric Light Co., of Indianapolis, Ind., for $15,525.

Minnesota.—Northfield. The city has granted the Thomson Houston Co., of St. Paul, the right to put in an electric light plant, and work will be begun soon. The charge for each light will be $1, thus making it fully as cheap as oil.

Iowa.—Le Mars. The Le Mars Water & Light Co. intends putting in an incandescent plant of at least 500 lights capacity during the coming year. It has a capital stock of $100,000, and a franchise for 25 years. President, J. M. DUNN; Secretary and Treasurer; PETER EGAN, JR.

Washington Territory.—Olympia. The Olympia Electric Light Co. will put in a plant and light the city this winter.

Texas.—Marshall. The Phœnix Electric Light Co. has been organized by J. H. GATES and others. Capital stock, $25,000.——Sherman. A committee has been appointed to investigate the feasibility of erecting an incandescent plant. J. P. GEREN, Mayor.

Canada.—Sherbrooke, Ont. The Sherbrooke Gas & Water Co. has purchased the plant of the Royal Electric Light Co., and is constructing flumes and an electric station over its tower on the Magog river. The company is also building a suspension bridge, which is nearly completed, over the same river.——St. Johns, Ont. The city has made a contract with the Royal Electric Light Co. to light the city with 10 arc and 23 incandescent lights for $900 per annum for the term of five years. This is equal to $64.29 per arc lamp per annum.

The Frost Meter.—The American Frost Meter Co., of Boston, Mass., has issued a pamphlet of "meter tables", in which a description of the meter is given. It is an upright, single piston meter, with a reversing valve motion. The case is of cast-iron, but the main cylinder is lined with gun metal and the piston is faced with double cap packing, of hydraulic leather, except in the case of hot water meters, when it is entirely of gun metal. The piston rod operates the registering apparatus by means of a pawl and ratchet and also operates the regulating valve which has a slide valve actuated by the direct pressure of the liquid. The course of the water is changed with each movement of the vertical measuring piston, but without causing any water-hammer or shock to the meter, the discharge of water flowing through the meter being continuous. The sizes manufactured range from ½-in., with a capacity of 15 U. S. gals. per minute, to 3-in. with a capacity of 320 gals. This meter is in use at several water-works in England.

Norristown, Pa.—An injunction was applied for last month by THOMAS D. ABRAHAM, to restrain the Lower Merion Water Co. from diverting or appropriating any of the waters from Croton creek at their works until they have given sufficient bonds to cover the damage likely to be sustained, or, in case of failure to give bonds or make satisfactory settlement of said damages, to make the injunction perpetual. The company was chartered January 4, 1886, its purpose being to supply water to the public in Lower Merion Township, Montgomery Co., and elsewhere. MALCOLM PETERS is the Constructing Engineer, and RICHARD PETERS the Superintendent. The plaintiff's declaration is that the company has built a 20 ft. dam or breast across Croton creek at what was formerly Martin's dam. It has also erected pumping machinery which is to supply Bryn Mawr, Ardmore, Rosemont, Wayne, and, in fact, the whole lower portion of Lower Merion Township. It is further claimed that the plaintiff and his predecessors in title from time immemorial have had the use and full flow of the waters of Croton creek, and the diversion and appropriation thereof by the company not only greatly depreciates the value of the plaintiff's land, but does him injury in his mill and business.

Jersey City, N. J.—The high service pump which pumps all the water used in the Hudson City part of Jersey City broke down Dec. 6, and that part of the city was without water until a contract was made with the Hackensack Water Co. for a supply at the rate of $300 per day. The high service pump has been in use more than 10 years, and has broken down three times in 6 months. It broke down 6 months ago and the district was without water for three days. The Commissioners of Public Works ordered a new Worthington pump, but the Board of Finance refused to concur.——The last public hearing on the water supply question was held Dec. 7.

Rochester, N. Y.—The question of the storage of the water of the Genesee river in a reservoir at some point on the upper river for the purpose of securing a uniform and sufficient flow during the dry months, is still being discussed. Messrs. JAMES B. FRANCIS, of Lowell, Mass., CLEMENS HERSCHEL, of Holyoke, Mass., and J. T. FANNING, of Minneapolis, Minn., were retained as engineering experts to investigate and report upon the scheme and paid a visit to the city on Dec. 11.

Tonawanda, N. Y.—The new building for the Tonawanda Water-Works Co. is 105 ft. by 130 ft., with a smoke-stack 78 ft. high; the engine room is 35 by 60 ft.; boiler room, 40 by 40 ft.; coal room, 30 by 30 ft. In the building are two sets of Gaskill compound pumping engines, with a daily capacity of 2,000,000 galls. each, and two boilers 5 ft. by 16 ft. There are about 15 miles of wood pipe in the system, large extensions having been made in 1888. The contractors were the Michigan Pipe Co., of Bay City, Mich.

Water-Works.—***Massachusetts.***—Westfield. Another special town-meeting must soon be called to provide for the refunding of $115,000 worth of water bonds maturing April 1, 1889, as the annual town-meeting will not come early enough to admit of taking action on this matter then. The bonds bear 7 per cent. interest, and were issued 15 years ago. Probably they can be easily refunded at 4 per cent., thus saving the tax-payers over $3,000 a year, as renewals of the $50,000 worth expiring five years ago were taken by local banks at 4 per cent., although in the form of notes payable $5,000 yearly. The income from water rents has increased so rapidly that it is ample to meet the interest on bonds, and in addition the town gets its water for fire purposes, schools and public buildings and fountains for nothing.——Hyde Park. A town meeting will be held Dec. 19 to hear the report of the committee in relation to the purchase of the Hyde Park Water Co., and to take action thereon; the report is understood to be favorable to the purchase.

Connecticut.—Mystic. The Mystic Valley Water Co. has held its annual report and elected officers for the ensuing year.

New York.—Sandy Hill. The new water-works were inspected and given a preliminary test recently by the insurance men.——Fort Edward. There is a proposition to obtain a water supply from Sandy Hill, but it is thought the supply may not be adequate.——East Randolph. The water-works question is again under discussion.——Rouse's Point. The recent election on the question of new water-works resulted in 27 votes being unfavorable, out of a total of 37.——Sea Cliff. The Trustees will defer the construction of the new water-works until next spring.——Salamanca. The water-works system is to be extended for fire protection.

Pennsylvania.—Lancaster. The Lititz Water Co. has declared a dividend of 6 per cent.——Reading. On Dec. 5 the mayor signed the bill authorizing the Water Department to bring in the waters of the Maiden creek. Work will be begun at once, so as to make the supply available by next summer. The stream has a flow at low water of 20,000,000 galls. daily. The signing of the bill gives great satisfaction to the manufacturers, who have been urging the project for the past year.

Kentucky.—Russellville. J. M. MCCUTCHEN is interested in the new water-works scheme.——Henderson. The city will lay a water main to Audubon at a cost of about $1,600.——Pineville. John Nichols has the contract to lay about 8 miles of pipe for the Pineville Water-Works Co.; 3 miles will be for bringing the supply from the Cumberland river.

Tennessee.—Johnson City. Two propositions to build water-works have been made; by J. F. WILDER and F. A. STRATTON and JOHN J. ROBINSON.

Mississippi.—Jackson. Ground has been broken for the foundation of the stand-pipe; the franchise is owned by Moffett, Hodgkins & Clarke, of Watertown, N. Y.

Missouri.—Washington. The stand-pipe will be 125 ft. high, it will have 25 rings of steel plates, each 5 ft. high, and each ring will be of 3 plates. The pipe will have a capacity of 150,000 galls.——The pumps furnished by the Pond Engineering Co., of St. Louis, have been tested.

Kansas.—Fredonia. The water-works question was settled Dec. 4. In March, 1887, the City Council granted a 20 years franchise to JAMES A. O'NEIL. The succeeding Council repealed the franchise, while the work was nearing completion. The present Council submitted the question to a legal vote, which resulted in favor of the water company by 107 majority. The works are complete, with 7 miles of piping and a reservoir, with a capacity of 3,000,000 galls., located on a mound near the city, 171 ft. high. The company at present supplies 50 double discharge hydrants for city use at an annual rental of $3,000. The works have cost from $80,000 to $100,000.——Fort Scott. Additional fire plugs are to be put in.

Iowa.—Des Moines. The Des Moines Water Supply Co. has been incorporated by H. D. THOMPSON and F. C. HUBBELL; capital stock, $1,000,000.

Arkansas.—Helena. J. W. TERRY, representing St. Louis capitalists, has been in the city for the purpose of negotiating for the construction of water-works. He will secure a franchise from the City Council.

California.—Suisun City.—The City Trustees are circulating a petition to bond the town for $13,000 for a system of water-works for fire protection. The proposed plan is to erect a tank 75 ft. high, and use slough water, which will be piped throughout the town, with hydrants at every street corner.——Folsom City. Water-works are projected by the Natrona Water Co.——Santa Barbara. The Santa Barbara Water Co. has been incorporated by J. W. CALKINS, I. K. FISHER, H. K. WINCHESTER, R. B. CANFIELD, and A. W. CANFIELD, of Santa Barbara; S. W. OSTERHOUT and WILLARD BARNHART, of Grand Rapids, Mich. Capital stock, $500,000; subscribed, $200,000. The company will absorb the Mission and the De la Guerra companies, and about the first of next year will add a large pumping plant and make other improvements.

Texas.—Hitchcock. The Gulf, Colorado & Santa Fé Ry. Co. has a pump and a tank with a capacity of 50,000 galls. The town has no water supply and no prospect of getting any for some time unless it is from artesian wells, which will be abundant for stock purposes only. The water is slightly salty in a 41 ft. well; surface water is good in a well 20 ft. deep but scarce and not sufficient for trains. The population is 300.

Canada.—Port Arthur, Ont. On Dec. 7 the City Council ratified the contract with the water company.—Lorneville. Water-works are projected.

New London, Conn.—The committee appointed to consider the advisability of laying a new main of 20-in. iron pipe from the 24-in. pipe to the city at a cost of $100,327, as recommended in the report of the Water Commissioners in September, has reported in favor of laying the main as soon as practicable; the committee also recommends as a protection from fire in parts of the city where the pressure is not sufficient for fire purposes even after the main is introduced, the erection of a stand-pipe, tank or reservoir at a cost of $16,000. The report was made after consultation with W. H. RICHARDS, C. E., engineer and superintendent of the water-works. The council has adopted the report.

Special Reports of Water-Works Construction.

PICTON, Ont., Dec, 6, 1888.

EDITOR ENGINEERING NEWS:—As our town is well supplied with good water from wells, we never could have passed a by-law to raise money for works for other than fire protection. The vote of the people was taken Aug. 21, 1888, authorizing the council to issue debentures to the amount of $30,000, at 5 per cent. payable in equal annual payments for 30 years. A tender from E. L. DE LA VALLE has been accepted, he agreeing to cover all cost of construction, and to supply 1,000 ft. of hose and two hose carts for $27,350.

The engineer for the works is THOS. A. BOLGER, Kingston, Ont. Work will begin as soon as practicable, say April, 1889, and be finished Sept. 1, 1889. The supply will be pumped from the Bay of Quinte to a reservoir 100 ft. sq., 200 ft. above the bay, and from 120 to 200 ft. above the town. There will be a compound duplex direct-acting pumping engine with a capacity of 400,000 imperial gallons in 24 hours. The mains will be 8, 4 and 6-in. in diameter, about four miles at first.

When the works are completed, I am satisfied that we will have a revenue from water takers. We have arranged for special castings at all places where there may be a future call for street mains. Our present aim is to place hydrants in such places that with 500 ft. of hose we can reach any building in the business part of the town, and with from 1,000 to 1,500, in the outlying portions. This requires about 35 hydrants. Our population is 3,200.

WM. J. PORTE, *Mayor.*

CAPAC, Mich., Dec. 7, 1888.

EDITOR ENGINEERING NEWS.—Our population is about 500, and we are building, under direction of the Village Trustees, water-works for fire protection. The supply is pumped from a well to a tank. The well is tubular to rock, then drilled. The pump is driven by a windmill, and the tank has a capacity of about 16,000 galls. Work was begun July, 1887, and the well and tank are just completed. For the present we shall attach hose of a hand engine to the tank, but it is our intention to put down mains and hydrants next year. The works have cost $700.

D. PATERSON.

The Michigan Pipe Co., Bay City, Mich., sends under date of Dec. 8, the data given below regarding water-works at Gaylord, Gladwin, Ovid, Pinconning and Vassar, Mich. In each case the works are owned by the village, and the above company furnished the pumping machinery and pipe and laid at the latter. At Pinconning and Vassar they were contractors for the whole system. They have also furnished 2,500 ft. of 6-in. wooden pipe for the new works at Lake City, Mich.

Gaylord, Mich.—Construction was begun May 1, and finished in Sept., 1888. Water is pumped from a well to a tank 16 by 30 ft., the pump being a 100,000-gall. deep-well pump. Two miles of 4 and 6-in. wood pipe have been put in. 18 Gaskill hydrants, and Galvin valves. The ordinary pressure is 30 lbs. The cost of the works is $7,000, and the debt $8,000, at 6 per cent. interest. The population is 1,200, and F. A. BALDWIN is the Village President.

Gladwin, Mich.—The population is 1,000, and W. W STEELE is Village President. Work was begun in Dec. 1888, and will be finished Jan. 1, 1889. A 1,000,000-gall. Gordon & Maxwell pump forces water from a spring directly through 1 mile of 4 and 8-in. wooden mains. There are 9 Gaskill hydrants, and the valves are Galvin. The works cost $6,000, and have a debt of $7,000 at 7 per cent.

Ovid, Mich.—Population, 2,000. Work was begun in April, and finished Nov., 1888. Direct pumping is used, water being taken from wells by a 1,500,000-gal. Gordon & Maxwell pump. There are 3½ miles of 2 to 8-in. wooden pipe, 32 Gaskill hydrants, and Galvin valves. The ordinary pressure is 40, and the fire pressure, 80 lbs. The cost of the works is $15,000. BURROUGHS is Mayor.

Pinconning, Mich.—Population, 1,200. Work begun Sept., '88, and will be finished Jan. 1, 1889. The supply is from an artesian well, by direct pumping, a 1,000,000-gall. Smith & Vaile pump being used here. There are 2 miles of pipe, 14 Gaskill hydrants. Galvin valves are used. The works will cost $8,000, and the debt will be $7,000 at 7 per cent. Superintendent, S. A. MCDOUGAL.

Vassar, Mich.—Population, 3,000. Work begun October, 1888, and will be finished Jan. 1, 1889. The supply is from a well and the river, by pumping to stand-pipe. There is a Holly-Gaskill pump with a capacity of 1,500,000 galls. The stand-pipe is 15 ft. in diameter and 80 ft. high, and there will be 4½ miles of 4 to 12-in. wooden pipe and 54 Galvin and Mathews hydrants. Galvin valves are used. The works will cost $20,000, and there will be a debt of $30,000 at 5 per cent. R. G. MYAN is Village President.

The descriptions of the following Illinois works were kindly given by Geo. C. MORGAN, Chicago, under date of Dec. 8, 1888. Mr. MORGAN designed and constructed them and they are owned by the respective villages:

Hoopestown, Ill.—Population, 2,800. The works were begun July 1, and finished November, 1888, the supply being pumped from a deep well and surface reservoir to a Morgan's special water tower, with a capacity of 30,000 galls. Two 1,000,000 galls. Deane pumps are used, and distribution is by 2½ miles of 8, 6 and 4-in. cast-iron pipe. The hydrants are of the Morgan, and the valves of the Crane pattern. The works cost $20,000. A. H. TREGO is Mayor.

Mendota, Ill.—Population, 5,000 to 6,000. The works were begun Oct. 8, 1888, and will be put in operation about Jan. 1, 1889. Water passes from an artesian well to a reservoir of 150,000 galls. capacity, and from there is pumped to a tower 118 ft. high, by a 750,000 gall. Deane high-pressure pump. There are two miles of pipe. Morgan hydrants and Crane valves are used. A. J. LAMBERTON is Mayor.

Jerseyville, Ill.—An artesian well has been sunk 2,000 ft., but a satisfactory quantity or quality of water has not been obtained. When water is found the works will be built by Mr. MORGAN, to be owned by the village. Population, 4,000.

So. Evanston, Ill.—The supply is taken from Lake Michigan, through an inlet pipe, then raised by two 1,500,000 gall. Deane pumps to a Morgan's special water tower with a capacity of 30,000 galls. There are 15 miles of cast-iron pipe. Chapman valves and hydrants are used. The ordinary pressure is 35, and the fire pressure 110 lbs. The cost of the works is about $60,000. Construction was begun April 1, and finished June 1. T. D. BEESE and P. E. O'NEIL are connected with the works.

Marinette, Wis.—The American Water-Works & Guarantee Co. Ltd., of Pittsburg, Pa., has completed the works here, and they have been formally accepted by the City Council, after a very satisfactory fire test, in which the company proved its ability to furnish more than the contract requirements stipulated in the number of fire streams and quantity of water. The works were built under the direction of J. H. PURDY, with C. D. BARSTOW, C. E., resident Superintendent, as assistant. The submerged pipe-laying was done by M. WALKER of Fenton, Mich., and A. W. STEVENS of Logansport, Ind. The other pipe-laying was done by A. W. STEVENS, contractor, Logansport, Ind. All the submerged pipe stood the pressure of 150 lbs., as did the mains throughout the city. The works will be managed during the winter by C. D. BARSTOW, and have a very favorable outlook, the company having secured during the past season between 480 and 500 water takers.

DEVIL'S LAKE, Dak., Dec. 8, 1888.

EDITOR ENGINEERING NEWS:—An artesian well has been successfully sunk, and we expect that the natural force will be sufficient for the pressure required in a complete system of water-works. The estimated cost of the works is $10,000, and our population is 1,200.

C. M. FISHER.

GLENWOOD, Ia., Dec. 6, 1888.

EDITOR ENGINEERING NEWS:— Our population of 2,000 is supplied from surface wells and cisterns, but an artesian well is now being sunk by the American Well Works Co., Aurora, Ill. If the well is a success, one or more will be our source of supply, and we hope for a natural head sufficient for all purposes. If the well is not a success, it is probable that a system for fire protection, only, will be contracted for, the supply to be taken from Keg creek, by direct pumping.

SETH DEAN.

TIPTON, Ia., Dec. 6, 1888.

EDITOR ENGINEERING NEWS:—An artesian well has been sunk 2,700 ft., and water rises within 70 ft. of the surface. We shall let contracts for works within 60 days, pumping from the well to a reservoir, the works to be owned by the village, and their cost, $20 000, to be met by bonds, already voted. The length of pipe has not yet been determined. Tipton is a village of about 2,000 inhabitants.

A. LAUGHAM, Mayor.

COOLIDGE, Kan., Dec. 7, 1888.

EDITOR ENGINEERING NEWS:—The Peck Water Co will put its works in operation between Jan. 1 and Mar. 1, 1889. The pipe is now nearly laid, the pump-house reservoir and artesian well finished. The well is 6-in. in diam., 2989½ ft., deep, and has a daily flow of 172,800 galls. of fine water. We have a reservoir with a capacity of 200,000 galls., from which a 1,250,000-galls. duplex pump lifts water to a 3,600-barrel stand-pipe with a capacity of about 100,000 galls. The works have cost a little over $30,000, all of which is capital stock. The franchise is for 50 years. The works were designed by E. H. PECK, and the Constructing Engineer was WM. FANKESLEY. E. N. PECK is President, and E. H. PECK, Secretary and Treasurer of the company. Our population is 1,500. E. H. PECK.

NORTON, Kan., Dec. 8, 1888.

EDITOR ENGINEERING NEWS:—Our works were begun May 1, and finished July 10, 1888, with Davis & Worthington as engineers, and E. SUTPHIN, St. Louis, Mo., as contractor. The supply is pumped to a stand-pipe from 8 Wagner wells, 27 ft. deep, the pump being a 500,000-gall. Deane, and the stand-pipe 12 ft. in diameter, 100 ft. high, and having a capacity of 85,000 galls. There are 5 miles of 6 and 4-in. cast-iron pipe, the last 3½ miles of which were laid by Davis & Worthington. We now have 110 taps, no meters, 14 hydrants, and Arthur valves. The works have cost $35,000, which was covered by bonds. The operating expenses are about $1,000, and the revenue from consumers is $1,500 a year. The population of Norton is 2,200.

DAVIS & WORTHINGTON.

BATESVILLE, Ark., Nov. 30, 1888.

EDITOR ENGINEERING NEWS:—A home company has been organized to build works with J. N. REED as Vice President, and JAS. LARWEN as Secretary and Treasurer.

F. D. DENTON.

We learn from Mr. REED that nothing as been done but to incorporate the company.

ST. JOHN, Ore., Dec. 5, 1888.

EDITOR ENGINEERING NEWS.—There is a water company here, and their well is now down 130 ft., but they have not struck water. Full information can be obtained from Messrs. Fulton, Cook, Scott & Co.

W. H. LIVERMORE.

HAYWARD, Cal, Dec. 1, 1888.

EDITOR ENGINEERING NEWS:—KNOX Bros. have a 50 years franchise for water-works here, which they put in operation Oct. 15, they being engineers for the system, and doing all the work but that for masonry. Water is pumped from a well to reservoir and direct, the pump being from the Dow Steam Pump Works, San Francisco, and having a daily capacity of 600,000 galls. The reservoir is 52 by 100 ft., by 16 ft. deep, and holds 650,000 galls. There are five miles of 4, 5 and 8-in. black iron pipe, furnished by W. W. Montague, San Francisco. Also 60 taps, 6 meters and 22 hydrants. The valves and hydrants are of a common pattern, and the meters were made by the San Francisco Tool Co. The pressure ranges from 30 to 80 lbs. to the square inch. Our population is 2,000.

W. KNOX.

Chattanooga, Tenn.—The population of this city has increased from 32,000 in 1887 to 41,000 in 1888. To keep pace with this the water-works system built during the war by the government has been rapidly extended to meet the demands made upon it, until it has now, under the ownership and name of the City Water Co., grown to be a pipe line of over 50 miles, from 20 in. in diameter, downwards. Last summer the works delivered at the rate of 7,000,000 galls. of water daily to its customers, and the present daily demand for water keeping up to 5,000,000 galls. necessitates the putting in of a second 6,000,000-gall. pump for which bids are now being received. This will be particularly necessary in the spring as this company has just closed long time-contracts to furnish water for both fire protection and domestic supply to the East End Land Co., the Ridgedale Land Co. and one other land company located at the base of Mission Ridge, a suburban section of Chattanooga.

The fire protection will be from a large reservoir which is to be built immediately on Mission Ridge, and which will give fire protection by gravity to the suburban, as well as the entire business part of Chattanooga.

It is the expectation of the present company to extend its mains through all the suburban parts of Chattanooga, which will necessitate the laying of from 10 to 12 miles of cast-iron pipe. The City Water Co. is the successor of the old Lookout Water Co.